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College Park, Maryland
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1980/1981 Graduate Catalog

University of Maryland
at College Park

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1980/1981
Graduate Catalog

University of Maryland
at College Park

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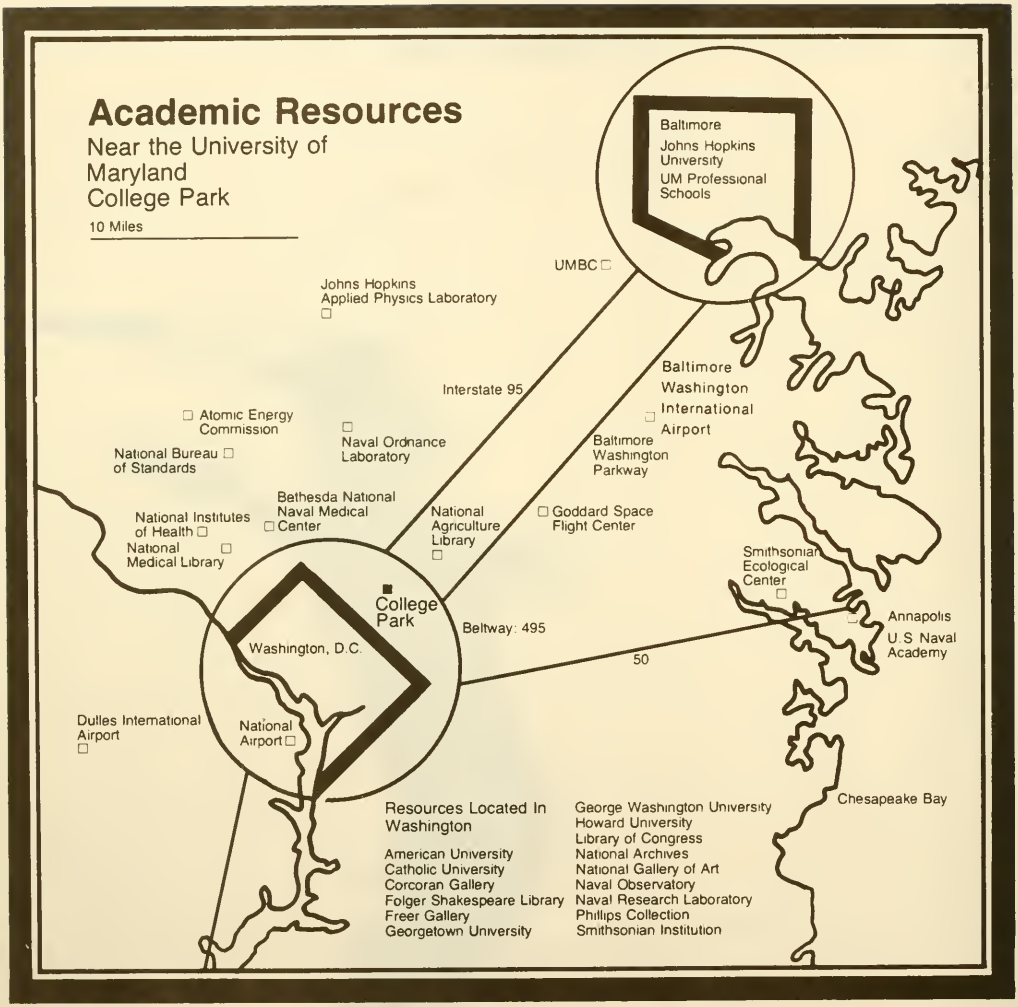
Academic Resources
Near the University of Maryland College Park
10 Miles
Baltimore
Johns Hopkins University
UM Professional Schools
UMBC
Johns Hopkins Applied Physics Laboratory
Interstate 95
Baltimore Washington International Airport
Atomic Energy Commission
Naval Ordnance Laboratory
National Bureau of Standards
Baltimore Washington Parkway
Bethesda National Naval Medical Center
National Institutes of Health
National Medical Library
National Agriculture Library
Goddard Space Flight Center
Smithsonian Ecological Center
College Park
Washington, D.C.
Beltway: 495
50
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U.S. Naval Academy
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National Airport
Chesapeake Bay
Resources Located In Washington
American University
Catholic University
Corcoran Gallery
Folger Shakespeare Library
Freer Gallery
Georgetown University
George Washington University
Howard University
Library of Congress
National Archives
National Gallery of Art
Naval Observatory
Naval Research Laboratory
Phillips Collection
Smithsonian Institution

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Academic Calendar

Fall Semester, 1980

August 25, 26	*Monday, Tuesday*	*Registration*
August 27	*Wednesday*	*Classes Begin*
September 1	*Monday*	*Labor Day*
November 26, 27, 28	*Wednesday–Friday*	*Thanksgiving Recess*
December 12	*Friday*	*Classes end*
December 13, 14	*Saturday, Sunday*	*Exam Study Days*
December 15–22	*Monday-Monday*	*Finals*
December 22	*Monday*	*Commencement*

Spring Semester, 1981

January 12, 13	*Monday, Tuesday*	*Registration*
January 14	*Wednesday*	*Classes Begin*
January 15	*Thursday*	*Martin Luther King Day*
March 15–22	*Sunday-Sunday*	*Spring Break*
May 6	*Wednesday*	*Classes End*
May 7	*Thursday*	*Exam Study Day*
May 8–15	*Friday-Friday*	*Finals*
May 15	*Friday*	*Commencement*

Summer Session, 1981 (tentative schedule)

Session I

May 18	*Monday*	*Registration*
May 19	*Tuesday*	*Classes Begin*
May 25	*Monday*	*Memorial Day*
June 26	*Friday*	*Classes End*

Session II

June 29	*Monday*	*Registration*
June 30	*Tuesday*	*Classes Begin*
August 7	*Tuesday*	*Classes End*

Fall Semester, 1981 (tentative schedule)

August 24, 25	*Monday, Tuesday*	*Registration*
August 26	*Wednesday*	*Classes Begin*
September 7	*Monday*	*Labor Day*
November 25–27	*Wednesday-Friday*	*Thanksgiving Recess*
December 11	*Friday*	*Classes End*
December 12, 13	*Saturday-Sunday*	*Exam Study Days*
December 14–21	*Monday-Monday*	*Finals*
December 21	*Monday*	*Commencement*

Plan of Academic Organization

Division of Agricultural and Life Sciences:

College of Agriculture:
- Agricultural and Extension Education
- Agricultural and Resource Economics
- Agricultural Engineering
- Agronomy
- Animal Science
- Dairy Science
- Horticulture
- Institute of Applied Agriculture
- Poultry Science
- Veterinary Science

Other Units within the Division:
- Biochemistry
- Botany
- Chemistry
- Entomology
- Geology
- Microbiology
- Zoology

Division of Arts and Humanities:

School of Architecture

College of Journalism

Other Units within the Division:
- American Studies Program
- Art
- Classics
- Communication Arts and Theatre
- Dance
- English
- French and Italian
- Germanic and Slavic
- History
- Music
- Oriental and Hebrew
- Philosophy
- Spanish and Portuguese

Division of Behavioral and Social Sciences:

College of Business and Management

Other Units within the Division:
- Afro-American Studies
- Anthropology
- Bureau of Business and Economic Research
- Bureau of Governmental Research
- Center for Industrial Relations and Labor Studies
- Center for Philosophy and Public Policy
- Economics
- Geography
- Government and Politics
- Hearing and Speech Sciences
- Institute for Urban Studies
- Institute of Criminal Justice and Criminology
- Maryland Technical Advisory Service
- Psychology
- Sociology
- Women's Studies

Division of Human and Community Resources

College of Education:
- Administration Supervision and Curriculum
- Counseling and Personnel Services
- Early Childhood-Elementary Education
- Industrial Education
- Institute for Child Study
- Measurement & Statistics
- Secondary Education
- Special Education

College of Human Ecology:
- Family and Community Development
- Foods, Nutrition and Institution Administration
- Housing and Applied Design
- Textiles and Consumer Economics

College of Library and Information Services

College of Physical Education, Recreation and Health:
- Health Education
- Physical Education
- Recreation

Division of Mathematical and Physical Sciences and Engineering

College of Engineering:
- Aerospace Engineering
- Chemical Engineering
- Civil Engineering

Electrical Engineering
Mechanical Engineering
Other Units within the Division:
Computer Science
Institute for Physical Sciences and Technology
Mathematical Statistics
Mathematics
Meteorology
Physics and Astronomy

University Officers

Board of Regents

Mrs. Mary H. Broadwater
The Hon. Wayne A. Cawley, Jr., *ex officio*
Mr. Percy M. Chaimson
Mr. Ralph W. Frey
Dr. Samuel H. Hoover
The Hon. Blair Lee, III
Mr. Peter F. O'Malley
Mr. A. Paul Moss
Mr. Allen L. Schwait
Mrs. Constance C. Stuart
The Hon. Joseph D. Tydings
Mr. Wilbur G. Valentine
Mrs. Jennifer A. Walker
Mr. John W. T. Webb
Mr. George W. Wilson, Jr.

Central Administration of the University

President
John S. Toll

Executive Vice President
Albin O. Kuhn

Vice President for General Administration
Warren W. Brandt

Vice President for Academic Affairs
David Adamany

Vice President for Graduate Studies and Research
David S. Sparks

Vice President for Agricultural Affairs and Legislative Relations
Frank L. Bentz, Jr.

Vice President for Development
Robert Smith

College Park Campus Administration

Chancellor
Robert L. Gluckstern

Vice Chancellor for Academic Affairs
Nancie L. Gonzalez

Vice Chancellor for Administrative Affairs
Darryl W. Bierly

Vice Chancellor for Student Affairs
William L. Thomas, Jr.

Provosts at College Park

Division of Agricultural and Life Sciences
Larry N. Vanderhoef

Division of Arts and Humanities
Shirley S. Kenny

Division of Behavioral and Social Sciences
Murray Polakoff

Division of Human and Community Resources
George J. Funaro

Division of Mathematical and Physical Sciences and Engineering
Frank Kerr

Deans at College Park

School of Architecture
John W. Hill

College of Agriculture
Earl Brown

College of Business Management
Rudolph P. Lamone

College of Education
Vacant

College of Engineering
George E. Dieter, Jr.

College of Human Ecology
John R. Beaton

College of Journalism
Benjamin F. Holman (Acting)

College of Library and Information Services
Kieth C. Wright

College of Physical Education, Recreation and Health
Marvin H. Eyler

Administrative Dean for Graduate Studies and Research
Rose-Marie G. Oster

Administrative Dean for Summer Programs
Melvin N. Bernstein

Administrative Dean for Undergraduate Studies
Robert E. Shoenberg

Graduate School Officers and Staff

Dean for Graduate Studies and Research

Rose-Marie G. Oster, M.A., Stockholm University, 1956; Ph.D., University of Kiel, West Germany, 1958.

Associate Dean for Graduate Studies

Marie S. Davidson (Acting Associate Dean), B.S., Dillard University, 1959; M.S., University of Maryland, 1967; Ph.D., 1971.

Associate Dean for Research

Dalmas A. Taylor, B.A., Western Reserve University, 1959; M.S., Howard University, 1961; Ph.D., University of Delaware, 1965.

Assistants to the Dean

Alice M. Piper, B.A., University of Pittsburgh, 1941.
Joanna F. Schmeissner, B.A., Agnes Scott College, 1960; M.A., Yale University, 1962.

Director of Graduate Admissions and Records

Jud Samon, B.A., University of Nevada, 1960; M.A., University of Maryland, 1964; Ph.D., 1979.

Assistant Director

Lois M. Lyon, B.A., University of Michigan, 1952.

Graduate Council, 1979–1980

Ex-officio Councillors

Chancellor Robert L. Gluckstern
Vice Chancellor Nancie L. Gonzalez
Acting Dean Robert E. Menzer
Acting Associate Dean Marie S. Davidson
Associate Dean for Research Dalmas A. Taylor

Appointed Councillors

Prof. Madeleine B. Therrien
Prof. Frank M. Hetrick
Prof. Dudley Dillard
Prof. David Clarke
Prof. William F. Hornyak

Elected Councillors

Mr. Robert Bray
Prof. Gilbert Castellan
Prof. Dean Tuthill
Prof. Bernard A. Twigg
Prof. Roger Meersman
Prof. Herman Belz
Ms. Sylvia Wagonheim
Prof. Milne Holton
Mr. Vincent Adams
Prof. Don C. Piper
Prof. David Horton
Prof. David Segal
Prof. Charlotte Leedy
Prof. Robert W. Ridky
Ms. Beverly Ann Hogg
Prof. Robert Huebner
Mr. David Kramer
Prof. Patrick F. Cunniff
Prof. Bruce Reinhart
Prof. Robert Glasser

Committees of the Graduate Council, 1979–1980

COMMITTEE ON ACADEMIC STANDARDS

Prof. Bruce Reinhart, Chairman, Mathematics, 1981
Prof. Richard T. Farrell, History, 1982
Prof. Martin Gannon, Business & Management, 1980
Prof. Robert G. Glasser, Physics, 1982
Prof. Robert A. Harper, Geography, 1982
Prof. Sidney R. Pierce, Zoology, 1981
Prof. Robert W. Ridky, Secondary Education, 1980
Prof. Victor Viola, Chemistry, 1982
Prof. Robert M. Wilson, Early Childhood/Elementary Education, 1980
Mr. David Kramer, Graduate Student, Mathematics, 1980
Ms. Edna Medford, Graduate Student, History, 1981
Dean Marie S. Davidson, *ex officio*

COMMITTEE ON ADMISSIONS

Prof. Mark Keeney, Chairman, Chemistry, 1980
Prof. Robert L. Bennett, Economics, 1981
Prof. Edward Buchler, Zoology, 1981
Prof. Randall Craig, Secondary Education, 1982
Prof. J. Dan Knifong, Early Childhood/Elementary Education, 1980
Prof. Richard McCuen, Civil Engineering, 1982
Prof. Allan Nash, Business & Management, 1981
Prof. Anne W. Nunamaker, Journalism, 1982
Prof. Ronald O'Leary, Communication Arts & Theatre, 1981
Prof. Peter Wolfe, Mathematics, 1980
Mr. Vincent Adams, Graduate Student, 1981
Mr. Michael Dolin, Graduate Student, 1980
Dr. Jud Samon, *ex officio*

COMMITTEE ON ELECTIONS

Prof. David Mills, Chairman, Psychology, 1982
Prof. Otto Best, Germanic & Slavic Languages, 1980
Prof. John Eliot, Human Development, 1980
Prof. Kenneth Felton, Agricultural Engineering, 1982
Prof. Robert Rivello, Aerospace Engineering, 1981
Mrs. Alice M. Piper, *ex officio*

COMMITTEE ON FELLOWSHIPS

Prof. Robert F. Carbone, Chairman, Administration, Supervision & Curriculum, 1980
Prof. Genette Ashby, French & Italian, 1982
Prof. Roger A. Bell, Astronomy, 1980
Prof. Richard Davis, Dairy Science, 1982
Prof. Parris N. Glendening, Government & Politics, 1980
Prof. E. Joan Hunt, Human Development, 1981
Prof. Everett Jones, Aerospace Engineering, 1982
Prof. Robert Munn, Chemistry, 1982
Prof. Craig Schneier, Business & Management, 1981
Prof. Raymond Thorberg, English, 1981
Mr. Walter J. Hayden, Graduate Student, Botany, 1980
Mr. Jerry Larson, Graduate Student, Criminology, 1981
Mrs. Joanna F. Schmeissner, *ex officio*

COMMITTEE ON GRADUATE FACULTY

Prof. Madeleine Therrien, French & Italian, 1980
Prof. Nancy Anderson, Psychology, 1982
Prof. Dewey Caron, Entomology, 1982
Prof. Saul Gass, Business & Management, 1982
Prof. Milne Holton, English, 1982
Prof. William Hornyak, Physics & Astronomy, 1981
Prof. Kenneth Kammeyer, Sociology, 1982
Prof. Billy V. Lessley, Agricultural & Resource Economics, 1980
Prof. Glenn W. Patterson, Botany, 1980
Prof. Walter Rundell, History, 1981
Prof. V. Phillips Weaver, Elementary Education, 1982
Dean Robert E. Menzer, *ex officio*

COMMITTEE ON PROGRAMS AND COURSES

Prof. Bernard A. Twigg, Chairman, Horticulture, 1980
Prof. Stephen Carroll, Jr., Business & Management, 1980
Prof. Gilbert Castellan, Chemistry, 1982
Prof. Kenneth N. Derucher, Civil Engineering, 1981
Prof. Dudley Dillard, Economics, 1981
Prof. Phillips Foster, Agricultural & Resource Economics, 1981
Prof. Roger Meersman, Communication Arts & Theatre, 1981
Prof. Mary R. Miller, English, 1982
Prof. Tonu Parming, Sociology, 1981
Prof. Betty F. Smith, Textiles & Consumer Economics, 1982
Prof. Cyril P. Svoboda, Human Development, 1980
Prof. Mostafa E. Talaat, Mechanical Engineering, 1982
Ms. Sylvia Wagonheim, Graduate Student, English, 1980
Ms. Loretta Wertheimer, Graduate Student, Counseling & Personnel Services, 1980
Dean Robert E. Menzer, *ex officio*
Dr. Richard Jaquith, *ex officio*

COMMITTEE ON PROGRAM REVIEW

Prof. Don C. Piper, Chairman, Government & Politics, 1981
Prof. Herman J. Belz, History, 1980
Prof. Everett C. Carter, Civil Engineering, 1980
Prof. Albert Gomezplata, Chemical Engineering, 1980
Prof. Robert Huebner, Human Development, 1981
Prof. David Horton, Psychology, 1982
Prof. Charlotte Leedy, Recreation, 1982
Prof. John Lembach, Art, 1981
Prof. Joseph Mattick, Dairy Science, 1982
Prof. Gerald R. Miller, Chemistry, 1980
Mr. Johnny Fairfax, Graduate Student, Recreation, 1981
Mr. Ronald Reis, Graduate Student, Secondary Education, 1980
Mr. Richard R. Zuccarelli, Graduate Student, Psychology, 1980
Dean Marie S. Davidson, *ex officio*

COMMITTEE ON PUBLICATIONS

Prof. Hans Wellisch, Chairman, Library & Information Services, 1980
Prof. James E. Alleman, Civil Engineering, 1982
Prof. Norman Heim, Music, 1982
Prof. Barry D. Smith, Psychology, 1981
Mr. Robert Bray, Graduate Student, Animal Sciences, 1981
Ms. Ellen Sirkis, Graduate Student, Communication Arts & Theatre, 1981
Mrs. Joanna F. Schmeissner, *ex officio*

COMMITTEE ON RESEARCH

Prof. J. Robert Anderson, Chairman, Physics, 1981
Prof. Marvin K. Aycock, Agronomy, 1981

Prof. Ferdinand Baer, Meteorology, 1982
Prof. Howard J. Brinkley, Zoology, 1982
Prof. Harold Brodsky, Geography, 1981
Prof. David Clarke, Physical Education, 1981
Prof. Jean R. Harber, Special Education, 1982
Prof. Frank M. Hetrick, Microbiology, 1981
Prof. Stuart B. Kaufman, History, 1982
Prof. George B. Macready, Measurement & Statistics, 1980
Prof. Graciela P. Nemes, Spanish & Portuguese, 1982
Prof. Merrill J. Roberts, Business & Management, 1980
Prof. David R. Schelling, Civil Engineering, 1982
Prof. William B. Walters, Chemistry, 1981
Mr. Charles Costa, Graduate Student, Zoology, 1981
Ms. J. Paoletti, Graduate Student, Textiles & Consumer Economics, 1980
Dean Robert E. Menzer, *ex officio*

COMMITTEE ON STUDENT LIFE

Prof. Jesse Roderick, Chairman, Early Childhood/Elem. Education, 1981
Prof. R. A. Brown, Psychology, 1982
Prof. Harvey Clearwater, Health Education, 1981
Prof. Walter W. Deshler, Geography, 1980
Prof. J. Kirkpatrick Flack, History, 1981
Prof. William V. Patterson, Communication Arts & Theatre, 1981
Prof. Thomas Regan, Chemical Engineering, 1982
Prof. William K. Rose, Astronomy, 1981
Prof. Dean Tuthill, Agricultural & Resource Economics, 1980
Prof. Franklin D. Westbrook, Counseling & Personnel Services, 1980
Prof. E. P. Young, Animal Science, 1982
Ms. Janet Headley, Graduate Student, Art History, 1981
Ms. Anne Suzuki, Graduate Student, Business & Management, 1980
Dean Marie S. Davidson, *ex officio*

University Policy Statement

The provisions of this publication are not to be regarded as an irrevocable contract between the student and the University of Maryland. Changes are effected from time to time in the general regulations and in the academic requirements. There are established procedures for making changes, procedures which protect the institution's integrity and the individual student's interest and welfare. A curriculum or graduation requirement, when altered, is not made retroactive unless the alteration is to the student's advantage and can be accommodated within the span of years normally required for graduation. When the actions of a student are judged by competent authority, using established procedure, to be detrimental to the interests of the university community, that person may be required to withdraw from the university.

It is university policy that smoking in classrooms is prohibited unless all participants agree to the contrary. Any student has the right to remind the instructor of this policy throughout the duration of the class.

Policies on Nondiscrimination

The University of Maryland is an equal opportunity institution with respect to both education and employment. The University's policies, programs, and activities are in conformance with pertinent federal and state laws and regulations on non-discrimination regarding race, color, religion, age, national origin, sex and handicap. Inquiries regarding compliance with Title VI of the Civil Rights Act of 1964, as amended, Title IX of the 1972 Education Amendments, Section 504 of the Rehabilition Act of 1973, or related legal requirements should be directed to the appropriate individual designated below.

Director, Human Relations Program
Main Administration Building
UMCP

Gender Reference

The masculine gender whenever used in this document is intended to include the feminine gender as well.

General Information

History

The history of the Graduate School at the University of Maryland, College Park has been one of rapid, at times almost explosive, growth. Established in 1919 with an enrollment of 13, the Graduate School has developed into one of the nation's largest. In the fall of 1979, there were approximately 7,500 graduate students enrolled in the more than 65 graduate programs and departments. In the academic year 1978–1979, 367 doctoral degrees and 1,255 master's degrees were awarded.

The Graduate School has matched its tremendous growth in size by an even more significant growth in its role as a center for the advancement of knowledge. The Graduate School has increasingly sought scholars of the highest quality, and today it numbers among its faculty men and women who have achieved national recognition and eminence in their fields. Active in scholarship in every area, students and faculty members of the Graduate School have designed equipment for the lunar space flights, excavated the gardens in Pompeii, performed important research in the unique ecological systems of the Chesapeake Bay, and won national awards for their creative work in fiction, poetry, and the arts.

The history of the Graduate School has been a history of growth in service as well as scholarship. Graduate programs at the University have always reflected the mission of the School as a servant to the State of Maryland. That mission is continued today more vigorously than ever in the numerous programs, centers, and special research projects through which graduate faculty and students address directly the needs of the residents of Maryland.

In the last two decades, the national impact of the Graduate School has become of major importance as well, with the ever increasing involvement of talented faculty and graduate students in the work of the many federal agencies, institutions, libraries, and programs in the nation's Capital.

Finally, the University of Maryland Graduate School is especially aware today of its mission to the wider community of man. The Graduate School not only has a large number of students and faculty from other countries, but it also is well represented in international conferences and symposia by faculty members who participate on a regular basis. In several divisions, there are specific projects and programs undertaken jointly with foreign universities, and the results of faculty research are published in international journals.

The Graduate School today is active and vital, conscious of its past growth and achievements and eager to develop more fully its potential as a leading educational and research institution. Its goal is to sustain and strengthen in every area the intellectual quality and commitment to service and significant scholarship that characterize the foremost graduate institutions.

National Organizations

In order to shape and participate in national policies and developments in graduate education, the Graduate School maintains close contact with other graduate schools and is a member of the following national organizations: the Association of American Universities, the Association of Graduate Schools, and the Council of Graduate Schools in the United States.

Major Role

The University of Maryland is keenly aware of the challenges facing graduate education today. The Graduate School has sought innovative and productive ways to adjust to the problems created by restricting financial realities and fluctuating opportunities for professionals in every field. In addition, the Graduate School has channelled many of its resources into a variety of academic services that meet the increasing demands of our society on universities.

In all of its activities, however, the Graduate School is guided by the belief that it can best serve society and respond to current challenges by a consistent and firm commitment to its traditional principles. Accordingly, the major role of the Graduate School is to provide for the education of students in the scholarly methods of intellectual inquiry and critical analysis; to train them in the discipline and skills necessary for beneficial research; and to foster in them a dedication to creative thought and the search for knowledge.

Not simply an extension of the colleges, schools, or divisions, the Graduate School is specifically designed to prepare those who will dedicate themselves to individual inquiry and service. To achieve this goal, it promotes the freedom and intellectual environment necessary to stimulate research and scholarship of the highest quality for both students and faculty.

Governance

The Graduate Faculty

In 1956 the Graduate Faculty adopted a formal constitution to "provide a means for the Graduate Faculty to discharge its functions with respect to educational policies and procedures of the Graduate School on this campus." That Constitution, as amended in 1968 and 1974, continues to govern the policies and procedures of the Graduate School on the College Park Campus.

The Graduate Faculty, working through the Assembly and the Graduate Council, establishes policies governing admission to graduate study and minimum requirements to be met by all students seeking advanced degrees in more than sixty-five graduate departments and programs leading to degrees awarded by the Graduate Faculty on the College Park Campus. The faculties of the individual academic departments and interdisciplinary graduate programs may establish additional requirements for admission or for degrees above the minima established by the Graduate Council.

The Assembly of the Graduate Faculty consists of all full and associate members of the Graduate Faculty who, through their participation in research and graduate instruction, have displayed a capacity for individual research or creative and scholarly work at the highest levels.

The Graduate Council consists of members of the Graduate Faculty elected by the Assembly, as well as appointed and *ex officio* members. It is charged with the formulation of the policies and procedures for the Graduate School of College Park including admission standards, the review of individual student programs, the review of all new programs and courses submitted by members of the Graduate Faculty, graduate student theses and dissertations, and the periodic review of all graduate degree programs. It meets approximately eight times a year to conduct its regular business and may be called into special session as the need arises.

In its work the Graduate Council is aided and advised by ten standing committees. Included are committees on: Academic Standards, Admissions, Elections, Fellowships, Program Review, Graduate Faculty, Programs and Courses, Publications, Research, and Student Life. Membership on these committees is limited to members of the Graduate Faculty and graduate students. Members are appointed by the Dean for Graduate Studies and Research for terms of three years.

Graduate Students

The value of student opinion and participation in determining matters of policy, procedure, and administration is appreciated and encouraged. In

addition to their appointment to the Committees of the Graduate Council, graduate students serve on many divisional and departmental committees.

Established in 1970, the Chancellor's Graduate Student Advisory Council (CGSAC) meets periodically with the Chancellor of the College Park campus and regularly on its own to discuss a wide range of issues affecting the graduate community (e.g. the role and mission of higher education; stipends for fellows, assistants, and researchers; parttime graduate student problems; redress of grievances; social activities; etc.). The Council also meets with administrative leaders from all fields and divisions as pertinent to problem solving and alternatives. In addition, the Council serves as a source of information to State Legislators and members of the Board of Regents. Membership is open to all interested students. For additional information, contact the Office of the Dean for Graduate Studies and Research.

Location

In location, faculty and students at the University of Maryland enjoy the best of all possible worlds. Situated on 1,300 acres in Prince Georges County, the College Park Campus is a part of the larger metropolitan area of Washington, D.C., which is rapidly becoming the nation's capital in cultural and intellectual activity as well as political power. The Kennedy Center for the Performing Arts, the Filene Center, and the many fine area theaters regularly present performances by the world's most exciting and renowned artists. The Smithsonian Museums and the National Gallery of Art, among others, sponsor standing collections and special exhibits that attract national attention. In addition to cultural activities, the nation's Capital provides interested students the opportunity to observe at first hand the work of federal institutions; to sit in the galleries of Congress; to watch the Supreme Court in session; and to attend public Congressional hearings. The possibilities for personal enrichment offered in this exciting cosmopolitan area are indeed enormous.

Outside the metropolitan area, and just minutes from the campus, the scene in the Maryland countryside is pleasantly rural. Maryland offers a great variety of recreational and leisure activities in its many fine national and state parks, from the Catoctin Mountains in Western Maryland to the Assateague Island National Seashore on the Atlantic bound Eastern Shore, all within a pleasant drive from the campus. Historic Annapolis, the state capital, is only a short drive away, and the city of Baltimore, with its rich variety of ethnic heritages, its cultural and educational institutions, and its impressive urban transformation, is only thirty miles from College Park.

Special Research Resources

The College Park Campus is in the midst of one of the greatest concentrations of research facilities and intellectual talent in the nation, if not in the world. Libraries and laboratories serving virtually every academic discipline are within easy commuting distance. There is a steady and growing interchange of ideas, information, technical skills, and scholars between the university and these centers. The libraries and facilities of many of these centers are open to qualified graduate students at the university. The resources of many more are available by special arrangement.

In the humanities, the Library of Congress and the Folger Shakespeare Library, with its extensive collection of rare manuscripts, are among the world's most outstanding research libraries. In addition, Dumbarton Oaks; the National Archives; the Smithsonian Institution; the World Bank; the National Library of Medicine; the National Agricultural Library; the Enoch Pratt Free Library of Baltimore; the libraries of the Federal Departments of Labor; Commerce; Interior; Health, Education, and Welfare; Housing and Urban Development; and Transportation, and approximately 500 other specialized libraries are all within a few minutes drive of the College Park Campus. These resources make the University of Maryland one of the most attractive in the nation for scholars of all disciplines.

The proximity of the Beltsville Agricultural Research Center of the United States Department of Agriculture has stimulated the development of both laboratories and opportunities for field research in the agricultural and life-sciences. The National Institutes of Health offer unparalleled opportunities for collaboration in biomedical and behavior research. Opportunities are also available for collaborative graduate study programs with other major government laboratories, such as the National Bureau of Standards and the Naval Research Laboratory.

The long-standing involvement of the State of Maryland in the development of the commercial and recreational resources of the Chesapeake Bay has resulted in the establishment of outstanding research facilities for the study of marine science at the University of Maryland Center for Environmental and Estuarine Studies, with research facilities at Horn Point near Cambridge, at Crisfield, and at Solomons Island, Maryland.

Campus facilities are also excellent for research in every discipline. Work in the behavioral sciences, particularly in learning, is centered in laboratories equipped for fully automated research on rats, pigeons, and monkeys.

Exceptional research facilities in the physical sciences include a 160 MeV cyclotron; two small Van de Graaff accelerators; an assortment of computers, including a PDP 11/45, a UNIVAC 1108 and a UNIVAC 1100/41; a 10 KW training nuclear reactor; a full scale low velocity wind tunnel; several small hypersonic helium wind tunnels; specialized facilities in the Institute for Physical Science and Technology; a psychopharmacology laboratory; shock tubes; a quiescent plasma device (Q machine) for plasma research; and rotating tanks for laboratory studies of meteorological phenomena.

Students also have access to research farms, greenhouses, and even laboratory-equipped vessels for research in the Chesapeake Bay. The University also owns and operates one of the world's largest and most sophisticated long-wavelength radio telescopes located in Clark Lake, California and a cosmic ray laboratory located in New Mexico.

Special Opportunities for Artists

Advanced work in the creative and performing arts at College Park is concentrated in the Tawes Fine Arts Building and the recently completed Art-Sociology Building. Creative work is greatly stimulated by the close interaction that has developed between the students and faculty of the University and the artists and scholars at the National Gallery, the Corcoran Gallery, the Hirshhorn Museum, the Phillips Gallery, the Museum of Modern Art, the Smithsonian Institution, as well as the musicians of the National Symphony Orchestra and small musical groups. The Kennedy Center for the Performing Arts and the Filene Center (Wolf Trap Farm Park) have further enhanced the climate for creative artists attending the University.

Outstanding work on campus in theater, dance, radio, and television is aided by the proximity of the campus to the National Theater, the Arena Stage, the Morris Mechanic Theater, and numerous little theater groups in the Washington and Baltimore area. There is a frequent and steady interchange of ideas and talent between students and faculty at the University and both educational and commercial radio and television media as a consequence of the large professional staffs which are maintained in the Washington area.

Libraries

The University library system includes major research libraries on both the College Park and Baltimore Campuses.

The Libraries on the College Park Campus contain nearly 2,000,000 volumes, and they subscribe to more than 15,000 periodicals and newspapers. Additional collections of research materials are available on microfilm, microfiche, phonorecords, tapes, and films.

The Theodore R. McKeldin Library is the largest library on campus and the principal library for graduate use. Special collections include those of Richard Von Mises in mathematics and applied mechanics; Max Born in the physicai sciences; Thomas I. Cook in political science; Romeo Mansueti in the biological sciences; Katherine Anne Porter; Maryland; U.S. government publications (for which the University is a regional depository); documents of the United Nations, the League of Nations and other international organizations, agricultural experiment station and extension service publications; maps from the U.S. Army Map Service; the files of the Industrial Union of Marine and Shipbuilding Workers of America; the Wallenstein collection of musical scores; and research collections of the American Bandmasters Association, the National Association of Wind and Percussion Instructors, and the Music Educators National Conference. In addition, the collections include microfilm productions of government documents, rare books, early journals, and newspapers.

Within the East Asia Collection is the world's largest repository of published and unpublished Japanese-language materials from the Allied Occupation period.

Graduate students at UMCP are not served by McKeldin alone. Several departments and colleges maintain specialized libraries for

student use, with collections of importance to advanced students. These include the Library of the College of Library and Information Services, which contains materials for library science and a Juvenile Teaching Materials Collection, and the Engineering and Physical Sciences Library, which houses the Technical Report Center with over 400,000 items from NASA, USDE, and other U.S. and foreign governmental agencies.

Our libraries have several exciting recent acquisitions which will be of special interest to graduate students. One new collection, to be known as the International Piano Archives at Maryland, contains more than 17,000 tapes, records and piano rolls, several thousand pieces of sheet music and scores, and important documents, letters and other materials relating to pianists Joseph Hofmann, Anton Rubinstein and others.

The University has also recently acquired an exceptional collection in astronomy: the entire library of the Georgetown University Observatory, which contains numerous catalogs, journals, and observatory bulletins dating back to the 1800's. Much of this material has never been published commercially, and when cataloguing is completed, Maryland will have one of the most interesting and extensive astronomy collections in the country.

Institutes, Centers, and Bureaus

Acknowledging the importance of an interdisciplinary approach to knowledge, the University maintains organized research units outside the usual department structures. These institutes, centers, and bureaus offer valuable opportunities for faculty and students to engage in research and study in specialized areas and in public service activities.

Institute for Child Study: Director: H. Gerthon Morgan. In its program the institute collects, interprets, and synthesizes the scientific findings in various fields that are concerned with human growth, development, learning and behavior. The Institute offers graduate programs leading to the Master of Education, Master of Arts, Doctor of Philosophy and Doctor of Education degrees, and the Advanced Graduate Specialist Certificate in the area of human development.

Institute of Criminal Justice and Criminology: Acting Director: Barton L. Ingraham. The Institute coordinates the University's interests and activities in the areas of law enforcement, criminology, and corrections. The Institute has a very extensive and carefully integrated undergraduate program. Special emphasis, however, is placed on graduate programs and on research. Recently, the University, through the Institute, was part of a seven-university National Criminal Justice Educational Development Consortium funded by the Law Enforcement Assistance Administration. The Consortium was established for a period of three years for the purpose of developing and strengthening doctoral programs in the field of criminal justice. The expansion of the Institute's graduate program under the impact of this grant has had a lasting effect on the scope and depth of graduate studies available to its students.

Other major research grants, such as the International Seminars and Training Programs in Criminal Justice awarded by the Law Enforcement Assistance Administration, and the Minority Prison Community Project funded by the Department of Health, Education and Welfare, as well as a number of smaller grants and contracts, add to the research and educational strength of the Institute. In combination, the research capabilities and the academic programs of the Institute make possible the achievement of its primary goal—the education of social and behavioral scientists who have chosen the problem of crime and its prevention and controls as their specialization. The Institute offers the M.A. degree with options in criminology or criminal justice and the Ph.D. degree in criminal justice and criminology.

Institute for Physical Science and Technology: Director: Joseph Silverman. The Institute for Physical Science and Technology is a center for interdisciplinary research in pure and applied science problems that lie between those areas served by the academic departments. These interdisciplinary problems afford challenging opportunities for thesis research and classroom instruction. Current topics of interest are: atomic physics, a wide variety of problems in plasma physics, statistical mechanics of physical and living systems, physics of the upper atmosphere and magnetosphere, fluid dynamics, physical oceanography, various aspects of space and planetary science, theoretical and applied numerical analysis, control theory, epidemiology and biomathematics, chemical processes induced by ionizing radiation, and the history of science. They also include analysis of a number of current problems of interest to society such as mathematical models applied to public health and many diverse efforts in basic mathematics.

Courses and thesis research guidance by the faculty of the Institute are provided through the graduate programs in the academic departments of the Division of Mathematical and Physical Sciences and Engineering. The Institute sponsors a wide variety of seminars. Of principal interest are general seminars in plasma physics, applied mathematics, fluid dynamics, and in atomic and molecular physics. Information about these can be obtained by writing the Director or by calling (301) 454–2636.

Institute for Urban Studies: Acting Director: Charles H. Levine. The Institute aims at developing students knowledgeable both in the technical competencies which constitute the skills of "urban manpower" and in the professional understanding of the urban community as an object of interdisciplinary analysis.

The Institute for Urban Studies is a multi-campus interdisciplinary B.A. and M.A. degree granting program. It was created to offer a teaching program to educate urban administrators and specialists to plan, manage and develop existing communities as well as to plan the development of new ones. The Washington-Baltimore urban corridor provides an excellent teaching and research setting for faculty and students. Since contemporary urban problems must be solved by a multi-disciplinary approach, the master's program supplements the Institute's core courses with the specialized problem solving methods of the diverse departments and professional schools of the University.

Center on Aging: Acting Director: Dan Fritz. Through research and teaching, the Center on Aging focuses its efforts on stimulating interest in aging within existing departments, colleges, and schools throughout the University. In addition, it has developed and maintains contact with students in the general field of gerontology and helps them to devise educational programs to meet their goals. The Center sponsors an ongoing colloquium series on aging and community training programs based primarily on psychosocial needs of the elderly. The Center and the College of Library and Information Services also maintain the Robert N. Butler Library, which contains an extensive collection of materials on aging and developmental psychology. In conjunction with participating departments and schools, the Center offers a certificate of concentration at the master's and doctoral degree levels, which require, in addition to formal coursework, a practicum experience in aging.

Arithmetic Center: Director: Robert Ashlock. The Arithmetic Center facilitates a graduate program in elementary school mathematics education—a program with an integrated focus relating mathematics, psychology, and learning. The faculty of the Center believe that crucial to the kind of research effort envisioned is a milieu conducive to such an effort—a physical-psychological locale in which students, faculty, participating children, parents, and appropriate visitors can become involved in the formal and informal interactions so essential to integrative research.

Center for Educational Research and Development: Co-directors: Gilbert R. Austin (UMBC), James Dudley (UMCP). The Center is committed to providing service to the State in the form of policy studies and analysis and to special educational training providing and sponsoring programs and workshops for legislators, board members, executive and legislative staff and agency personnel. The entire range of University programs and personnel are committed to these two tasks in an effort to provide an interdisciplinary approach to the Center's research and development activities. The Center acts as a facilitator and liaison between the external public agencies and bodies and the internal University resources. In so doing, it provides research and project opportunities for faculty and graduate students in education, the social sciences, business and a variety of other fields, to engage in issues of educational policy.

Computer Science Center: Director: John P. Menard. The Computer Science Center provides the academic community of the University with ready access to large-scale computer facilities. The Center's primary function is the effective operation, maintenance, and management of these facilities so as to provide, as nearly as possible, uninterrupted computer services to the University community. The Center also carries on an active program of basic and applied research in computer science.

Graduate students and faculty with programming problems can bring them to a group of programmer consultants who work on an individualized basis to assist in applying appropriate computer techniques. The Center also has a staff of systems analysts to assist in debugging programs, to adapt software developed elsewhere to use the Center's equipment, and to devise original software to meet user needs. There is a well-stocked program library, keypunch and digitek services are available, and the Center offers several non-credit short courses for new users or those with specialized needs.

The Center's basic hardware consists of a UNIVAC 1108 Shared Processor System and a UNIVAC 1100/42 system, along with other associated hardware. Two terminal rooms and two keypunch areas with

reproducer, interpreter and lister are maintained in the Computer Science Center. Terminals owned or leased by other departments can also access the Center's large-scale equipment.

Center of Industrial Relations and Labor Studies: Acting Director: Paul A. Weinstein. The Program of Industrial Relations and Labor Studies was recently organized at UMCP and is concerned with two kinds of activity. The first is interdisciplinary research directed primarily toward the study of labor-management relations, wages and related problems, the labor market, comparative studies and manpower problems. The Program draws on the expertise and interests of faculty from the College of Business and Management, the School of Law and the Department of Economics, History, Psychology and Sociology. The second main activity consists of community and labor relations education projects serving management, unions, the public and other groups interested in industrial relations and labor-related activities. These projects consist of public lectures, conferences, and symposia as well as non-credit courses. Discussions concerning the development of a Master's degree in Industrial Relations and Labor Studies are currently underway.

Center for Language and Cognition: Director: David L. Horton The purpose of the Center for Language and Cognition is to provide a central focus for instruction and research training on all aspects of language and cognition represented by the training staff. The Center's specific goals are to (1) encourage and support research and (2) to train students capable of making substantial contributions to the understanding of man's cognitive systems and of relating this understanding to behavior in natural settings. The training program is supported, in part, by a training grant from the National Institute of Mental Health.

Center for Philosophy and Public Policy: Director: Peter G. Brown. The Center for Philosophy and Public Policy conducts an interdisciplinary program which engages in research and curriculum development with the purpose of investigating conceptual and ethical aspects of public policy formulation and debate. Most research efforts—chosen from topics expected to be a focus of public policy debate during the next decade—are coordinated by Center research staff and conducted cooperatively by working groups composed of philosophers, policy-makers, analysts, practitioners, and Center staff. In its research efforts the Center seeks to create an improved understanding of the normative principles which are basic to an assessment of public policies. Research products are made available through commercial publication, distribution of course models, workshops and the distribution of working papers.

The Center's curriculum development seeks to bring philosophical issues before future policy-makers and citizens. To this end courses dealing with contemporary normative issues in the national and international arena are offered through the Departments of Philosophy and of Government and Politics and other departments whose disciplines are relevant to the specific course being taught. Courses which have been offered include: Hunger and Affluence, Human Rights and Foreign Policy, Philosophical Issues in Public Policy, Ethics and Welfare, Professional Responsibility, and Business Ethics and Social Responsibility. The Center is sponsored jointly by the Divisions of Arts and Humanities and of Behavioral and Social Sciences.

The Maryland Center for Productivity and Quality of Working Life: Director: Tom Tuttle. The Maryland Center for Productivity and Quality of Working Life operates within the College of Business and Management. The Center has four major functions: 1) to foster increased productivity and quality of working life through work with various public and private sector organizations in Maryland; 2) to act as a clearing house for information about productivity and quality of working life; 3) to increase knowledge levels about productivity and quality of working life in Maryland through the regular curriculum of the University, as well as through training programs sponsored by the Center; and 4) to conduct research which adds to the body of knowledge about productivity and the quality of working life.

Science Teaching Center: Director: Emmett L. Wright. The Science Teaching Center has been designed to serve as a model facility to fulfill its functions of undergraduate and graduate science teacher education, science supervisor preparation, basic research in science education, inservice aid to teachers and supervisors, and consultative services at all levels, kindergarten through university. Its reference library features relevant periodicals, science and mathematics textbooks, and new curriculum materials. Its faculty members are actively involved with professional societies and science education activities locally, nationally, and internationally.

Since 1962 the Science Teaching Center has served as the headquarters for the activities of the Science Teaching Materials Review Committee of the National Science Teachers Association. The Information Clearinghouse on Science and Mathematics Curricular Developments, the International Clearinghouse for A.A.A.S., N.S.F. and UNESCO, started here that year also. The "software" and "hardware" of science education are gathered within the center in what is considered to be one of the world's most comprehensive collections of such materials.

Transportation Studies Center: Director: Everett C. Carter. Sponsored by the College of Engineering and the College of Business and Management the Center acts as a catalyst to foster research and development and interdisciplinary studies in transportation and to provide the means for investigators from different disciplines to work together on a wide range of transportation related problems. Objectives of the Center are to identify potential research projects by establishing a dialogue and rapport with sponsoring agencies and offices; to provide coordination between the various disciplines engaged in or having potential to engage in transportation research and between potential research sponsors and University researchers; to facilitate cooperation between the University of Maryland and other universities and industry, for joint undertakings; to promote and, where appropriate, to supervise specific educational programs of an interdisciplinary nature.

Among the areas identified as having interest and research potential are transportation systems management, transportation planning, public policy, public utilities, systems economics, multiple uses of rights-of-way, mass transit systems, conservation of energy, terminal siting, bridge and pavement design, traffic flow coordination, traffic safety and efficiency, transportation economics, aerospace transportation, meteorological factors, noise control, highway landscaping, environmental considerations, and air, rail, water and highway alternatives.

Water Resources Research Center: Acting Coordinator: Fred Wheaton The Water Resources Research Center sponsors and coordinates research on all aspects of water supply, demand, distribution, utilization, quality enhancement or degradation, and allocation or management. A committee of water resource research information users, including representatives from management, planning and regulatory federal, state and local governments and citizens groups, has been formed to advise on research needs of Maryland. Basic funding is from the annual allotment of the Water Resources Research Act of 1964 as amended. The Center also assists faculty members in developing matching fund proposals and in seeking other research funds. Currently, there are nine research projects in progress in six different departments, including a project at UMBC and one at the Johns Hopkins University.

Bureau of Business and Economic Research: Director: Dr. John H. Cumberland. The Bureau of Business and Economic Research conducts research in the areas of regional, urban and environmental economics. Projects are funded by the University, and by State and Federal Government agencies. Research is conducted by Bureau faculty members, who hold joint appointments with the Department of Economics, and by advanced graduate students working on degree programs.

Bureau of Educational Research and Field Services: Director: Gerald V. Teague. The Bureau of Educational Research and Field Services was established to serve in a consultative capacity in implementing research designs of faculty members, graduate students and public school systems. It acts as a coordinating agency between the University and public school systems for both research and field services. The Bureau also serves as a source of information and assistance regarding federal and non-federal research support that is available.

Bureau of Governmental Research: Acting Director: Charles Levine. Activities of the Bureau of Governmental Research relate primarily to the problems of state and local government in Maryland. The Bureau engages in research and publishes findings with reference to local, state and national governments and their interrelationships. It undertakes surveys, sponsored programs and grants, and offers its assistance and service to units of government in Maryland. The bureau furnishes opportunities for qualified students interested in research and career development in state and local administration. The Bureau also acts as coordinator for the Annual School for Maryland Assessing Officers.

Maryland Technical Advisory Service: Acting Director: Patricia S. Florestano. The Maryland Technical Advisory Service provides consulting services to county and municipal governments of the state. Technical consultation and assistance are provided on specific problems in such areas as preparation of charters and codes of ordinances, fiscal management, personnel zoning, and related local or intergovernmental activities. The staff analyzes and shares with governmental officials

information concerning professional developments and opportunities for new or improved programs and facilities.

Consortia

The University of Maryland is a member of a number of national and local consortia concerned with advanced education and research. They offer a variety of opportunities for senior scholar and graduate student research.

OAK RIDGE ASSOCIATED UNIVERSITIES, INC. (ORAU), is a non-profit educational and research corporation formed in order to broaden the opportunities for member institutions collectively to participate in many fields of education and research in the natural sciences related to nuclear energy. Educational programs range from short term courses or institutes, conducted with ORAU facilities and staff, to fellowship programs administered by ORAU for the U.S. Department of Energy.

The National Center for Atmospheric Research (NCAR), in Boulder, Colorado, was created in 1960 to serve as a focal point of a vigorous and expanding national research effort in the atmospheric sciences. NCAR is operated under the sponsorship of the National Science Foundation by the UNIVERSITY CORPORATION FOR ATMOSPHERIC RESEARCH (UCAR), made up of 44 U.S. and Canadian universities with graduate programs in the atmospheric sciences or related fields. The scientific staff includes meteorologists, astronomers, chemists, physicists, mathematicians, and representatives of other disciplines.

UNIVERSITIES RESEARCH ASSOCIATION (URA), a group of 52 universities engaged in high energy research, is the sponsoring organization for the Fermi National Accelerator Laboratory, funded by the U.S. Department of Energy. The accelerator, located near Batavia, Illinois, is the world's highest-energy proton accelerator.

The INTER-UNIVERSITY COMMUNICATIONS COUNCIL (EDUCOM) provides a forum for the appraisal of the current state of the art in communications science and technology and their relation to the planning and programs of colleges and universities. The council particularly fosters inter-university cooperation in the area of communications science.

The UNIVERSITIES SPACE RESEARCH ASSOCIATION (USRA) was designed to promote cooperation between universities, research organizations, and the government in the development of space science and technology, and in the operation of laboratories and facilities for research, development, and education in these fields.

The University of Maryland is a member of the INTER-UNIVERSITY CONSORTIUM FOR POLITICAL SCIENCE RESEARCH. One purpose of the Consortium is to facilitate collection and distribution of useful data for social science research. The data include survey data from the University of Michigan Survey Research Center and from studies conducted by other organizations or by individuals, census data for the United States, election data, legislative roll calls, judicial decision results, and biographical data.

The University of Maryland jointly participates in the CHESAPEAKE RESEARCH CONSORTIUM, INC., a wide scale environmental research program, with the Johns Hopkins University, the Virginia Institute of Marine Science, and the Smithsonia Institution. The Consortium coordinates and integrates research on the Chesapeake Bay region at the Chesapeake Bay Center for Environmental Studies and is compiling a vast amount of scientific data to assist in the management and control of the area. Each participating institution calls on faculty expertise in a diversity of disciplines including biology, chemistry, physics, engineering, geology, and the social and behavioral sciences. Through this interdisciplinary research program a computerized Management Resource Bank is being developed containing a biological inventory of the Chesapeake Bay region, a legal survey, and socioeconomic data of the surrounding communities. The Consortium provides research opportunities for faculty members, graduate students, and undergraduate students at the University.

Officially chartered in 1969, the ASSOCIATION OF SEA GRANT PROGRAM INSTITUTIONS is a growing organization concerned with the development and wise use of ocean and Great Lakes resources. Composed of the nation's major colleges, universities and institutions with ocean programs, the Association works for the betterment of the management and utilization of marine resources.

The University of Maryland was awarded its first institutional Sea Grant funding by the Department of Commerce for the calendar year 1977. Although forty-six universities, colleges and non-profit organizations hold either regular or associate memberships in SGA, Maryland is one of only about a dozen who have comprehensive institutional programs and who are or are eligible to become Sea Grant Colleges.

The goal of the CONSORTIUM ON HUMAN RELATIONSHIPS IN EDUCATION is to involve all interested agencies in the State of Maryland in the identification, development, and utilization of the human resources of the State for the purpose of improving human relationships in education. Fourteen agencies, including local school systems and institutions of higher education, are currently active in the project.

Established in 1965, the UNIVERSITIES COUNCIL ON WATER RESOURCES (UCOWR), is a national consortium with approximately 80 members. UCOWR was created to provide a forum for interchange of information pertaining to water resources research in academic communities. Member institutions also exchange information on special conferences, seminars, symposia and graduate study opportunities.

The University of Maryland is an associate member of the UNIVERSITY-NATIONAL OCEANOGRAPHIC LABORATORY SYSTEM (UNOLS) established to improve coordinated use of federally supported oceanographic facilities, bringing together the Community of Academic Oceanographic Institutions which operate those facilities, and creating a mechanism for such coordinated utilization of and planning for oceanographic facilities. As an associate member, the University of Maryland has a very active graduate level research program in the marine sciences and operates facilities through the Chesapeake Bay Center for Environmental Studies.

The purpose of the SOUTH-EAST CONSORTIUM FOR INTERNATIONAL DEVELOPMENT is to respond to the economic and social needs of limited resource peoples and less developed countries. Membership in the organization is open to universities, research institutions and other organizations with capabilities related to rural and urban development and technology transfer.

Fees and Expenses

Payment of Fees

Registration is not completed or official until all financial obligations are satisfied. Although the University regularly mails bills to students, it cannot assume responsibility for their receipt. If a student does not receive a bill on or before the beginning of each semester, it is the student's responsibility to obtain a copy of the bill at Room 1103, South Administration Building, 8:30–4:30, Monday through Friday.

The University of Maryland does not have a deferred payment plan. Payment for past due balances and current semester fees are due on or before the first day of classes.

It is the policy of the University not to defer payment on the basis of a pending application for financial assistance to an outside agency, including Veterans Administration benefits, bank loans, guaranteed student loan programs, etc.

Students will be severed from University services for delinquent indebtedness to the University. In the event that severance occurs, the individual may make payment during the semester in which services were severed and all services except housing will be restored. *A $25.00 Restoration of Services fee* will be assessed in addition to payment for the total past due amount.

State of Maryland legislation has established a State Central Collections Unit, and in accordance with State law the University is required to turn over all delinquent accounts to that office for collection and subsequent legal action.

Refund of Fees

A Cancellation of Registration submitted to the Withdrawal and Reenrollment Office before the official first day of classes entitles the student to a full credit or refund of semester tuition.

After classes begin, students who wish to terminate their registration must follow the withdrawal procedures stated in the "Schedule of Classes." Students will find the necessary forms for withdrawal in the Withdrawal and Reenrollment Office. The effective date used in computing refunds is the date the withdrawal form is filed in the Withdrawal and Reenrollment Office. "Stop Payment" on a check, failure to pay the semester bill, failure to attend classes, do not constitute withdrawal.

A request for a refund must be processed by the student with the Division of Business Services; otherwise any credit on the student account will automatically be carried over to the next semester.

Students withdrawing from the University will be credited for tuition in accordance with the following schedule:

Period from date instruction begins	*Refundable tuition only (Additional fees non-refundable)*
Two weeks or less	80%
Between two and three weeks	60%
Between three and four weeks	40%
Between four and five weeks	20%
Over five weeks	No Refund

University Refund Statement

Tuition, refundable fees and refundable deposits are authorized for refund only if the student completes the prescribed withdrawal procedures or is dismissed from the University. Residence Hall and Dining Services charges are authorized for refund only if the student completes the prescribed residence hall and dining services contract release procedures. Please refer to current "Schedule of Classes" for complete refund informat and procedures.

Graduate Fees*

Application fee
This fee is not refundable.....$15.00[1]
Tuition Per Credit Hour:[1]
Resident Student.....$55.00
Non-Resident Student.....$100.00
Students admitted to the Graduate School must pay graduate tuition fees whether or not the credit will be used to satisfy program requirements. A graduate student who wishes to audit a course must pay the usual graduate tuition.
Continuous Registration Fee.....$10.00
Registration Fee[1].....$5.00
Recreation Fee
(Summer School Only)[2].....$4.00
Vehicle Registration Fee[2].....$12.00
Graduation Fee,
Master's Degree[2].....$15.00
Graduation Fee,
Doctor's Degree[2].....$60.00
Health Fee[1] (Per Semester).....$6.00
(Part-time Student)
Health Fee[1] (Per Semester).....$11.00
(Full-time Student)
Athletic Fee[1] (Per Semester).....$5.00
(Students taking 4 or more credits)

*The fees listed here are those charged at the time this Catalog went to press and are offered as a general guide. They are subject to change. Fees charged in a particular semester are published in the *Schedule of Classes* for that semester.
[1] non-refundable
[2] refundable

Determination of In-State Status for Admission, Tuition and Charge-Differential Purposes

An initial determination of in-state status for admission, tuition and charge-differential purposes will be made by the University at the time a student's application for admission is under consideration. The determination made at that time, and any determination made thereafter shall prevail in each semester until the determination is successfully challenged. *The deadline for meeting all requirements for an in-state status and for submitting all documents for reclassification is the last day of registration for the semester the student wishes to be classified as an in-state student.*

The volume of requests for reclassification may necessitate a delay in completing the review process. It is hoped that a decision in each case will be made within ninety (90) days of a request for determination. During this period of time, or any further period of time required by the University, fees and charges based on the previous determination must be paid. If the determination is changed, any excess fees and charges will be refunded.

Persons who are interested in obtaining a copy of the regulations or who wish assistance with their classification should contact: The Graduate School Office of Graduate Records, Room 2117, South Administration Building, University of Maryland, College Park, Maryland 20742—phone (301) 454–4004.

Financial Assistance

The University of Maryland recognizes the high cost of education today and makes every effort to offer financial assistance to qualified students through a variety of programs. Approximately one-half of all full-time graduate students receive financial support, which includes remission of tuition fees, through teaching and research assistantships and University and state fellowships. In addition, education loans are available through the University at very reasonable terms, and short-term, interest-free emergency loans may be obtained if needed. Referrals for on-campus or area employment opportunities for students and students' spouses are also available in various departments and in specific student service centers on campus.

Fellowships

A fellowship is an award bestowed on a student who displays academic merit and promise to assist him in devoting full time to scholarly pursuits. All applicants for fellowships must be admitted to the Graduate School on a full-time basis to be eligible. Inquiries and requests for appropriate forms should be directed to the Fellowships and Finance Office, Room 2126, South Administration Building, University of Maryland, College Park, Maryland 20742.

The Maryland Fellowship Program, established by the State Legislature and administered by the Graduate School, provides a limited number of fellowships to qualified applicants who are enrolled in doctoral programs and who agree to teach in a public institution of higher learning in the State of Maryland for a period of three years following receipt of their doctoral degree, if a suitable position is offered. The stipend is $3,500 for the academic year, with remission of tuition. Although renewable annually, these fellowships normally carry a three year non-renewable tenure. Deadline for the application, which is available from the Fellowship Office of the Graduate School is February 1.

The Graduate School Fellowships are awarded annually on a competitive basis. The stipend is $1,000 for the academic year, with remission of tuition. The standard application for financial aid will serve as an application for this fellowship program and must be submitted by February 1 directly to the department in which you seek admission. Awards are based upon the nomination and recommendation of the department chairman.

Other Race Grants have been established to provide financial assistance to qualified graduate students who meet the following criteria: 1. The applicant must be a member of a minority race as defined by the racial composition of the College Park Campus graduate student body. 2. The applicant must be a legal resident of Maryland. 3. The applicant must be admitted as a full-time graduate student in a degree program. 4. The applicant must be a first-time graduate student. 5. The applicant must be able to demonstrate financial need as determined by the College Park Graduate School. The individual fellowship shall not exceed $1,000. Tuition is also waived in most cases. Students may apply for reappointment on a yearly basis. Additional details and application materials are available from the Fellowships and Finance Office of the Graduate School. The deadline for applications is February 1.

Assistantships

Offers of assistantships are made contingent upon the applicant's acceptance as a graduate student by the Graduate School.

Graduate Teaching Assistantships are available to qualified graduate students in many departments and programs. In addition to remission of tuition, these carry ten-month or twelve month stipends ranging from $4,800 to $7,080. Applications for assistantships should be made directly to the department in which the applicant will study.

Graduate Research Assistantships, with comparable stipends, are available in some departments on a ten or twelve month basis. For information inquire in the individual department or program.

Resident Graduate Assistantships, in limited number, are also available. The stipend begins at $4,800 per year, plus remission of tuition, in exchange for part-time work in undergraduate residence halls as Residence Halls staff members. These Resident Assistantships are open to both men and women. Applications for a Resident Graduate Assistantship should be made to the Office of Human Resources, Department of Resident Life, Cumberland Hall, University of Maryland, College Park, Maryland 20742.

Loans and Part-Time Employment

National Direct Student Loan Funds are available to graduate students of the University of Maryland. Applicants must be United States nationals (citizens and permanent resident status). Loans are approved based upon financial need; the average loan is $1,500 per year. Repayment begins nine months after the borrower leaves school, and no interest is charged until the beginning of the repayment schedule. Interest after that date is charged at the rate of three percent per annum. Repayment of the loan, including interest, is deferred during the time the borrower may be in military service, the Peace Corps, VISTA, and ACTION, up to a period of three years as well as during time of continued study on at least a half-time basis. Applications should be directed to the Director, Office of Student Financial Aid, North Administrative Building, University of Maryland, College Park, Maryland 20742, by February 15 for the fall semester.

Guaranteed Student Loan programs which have been established for State of Maryland residents through the Maryland Higher Education Loan Corporation, permit students to borrow money from their hometown banks or other local financial institutions. Graduate students in good standing may borrow up to $5,000 per year, but state agencies and individual banks may set their own limits up to this amount. Notes may not bear more than seven percent simple interest. Monthly repayments begin ten months after graduation or withdrawal from school. The federal government will pay the interest for eligible students while the student is in school. Further details regarding this program for Maryland residents may be secured from the Office of Student Financial Aid. For prospective non-Maryland borrowers unable to obtain information concerning the particular loan programs of their states, the Office of Student Financial Aid can provide necessary information.

Student Emergency Loans are available, in case a student has a financial emergency, from the Office of Student Financial Aid. If the funds have not been depleted, students may borrow with no interest up to $75.00 ($300.00 if the student specifies that the loan is to help pay registration debts). Emergency loans must be repaid within one semester.

AAUW Loan: The College Park Maryland Branch of American Association of University Women has established a small AAUW loan fund for graduate women students at the University of Maryland. The amount loaned will be based on need and on the amount of funds available. Repayment of the loan shall begin within one year of leaving the University, and the note will carry 4 per cent per annum simple interest to be charged on the unpaid balance, beginning when the borrower leaves the University. For information and application forms, please contact the Fellowship and Finance Office in the Graduate School.

The Office of Student Financial Aid, located in the North Administration Building, serves without charge as a clearinghouse for students seeking part-time work and employers seeking help. Many jobs are available in the residence halls, libraries, laboratories, and elsewhere on and off campus. All full-time students seeking work are welcome to visit the office and consult referral lists.

Work-Study Program. The University has in operation a College Work-Study Program provided under Title 1–C of the Economic Opportunity Act of 1964 and subsequent amendments.

The purpose of the College Work-Study Program is to expand part-time employment opportunities for students who are in need of the earnings from part-time employment in order to continue their education. Preference is given to students with the greatest financial need.

Employment under the College Work-Study Program is available to a student who meets the following qualifications: (1) is in need of employment in order to pursue a course of study at this University; (2) is capable of maintaining good standing in the course of study while employed; (3) is a citizen of the United States or a permanent resident; (4) is enrolled or has been accepted for enrollment as either an undergraduate, graduate, or professional student on a full-time basis.

Students employed through the College Work-Study Program are assigned to most of the departments on campus and a few departments off-campus. Students may be employed up to 40 hours per week during the summer, semester break, and Spring holidays. During the school year, to include examination week, students may work up to 20 hours per week. Minimum pay for graduate students is currently $4.45 per hour during this school year.

Additional information may be obtained from the Office of Student Financial Aid, Student Employment Section, located in Room 2114, North Administration Building Telephone: 454–4592.

Golden Identification Card for Senior Citizens of Maryland

The purpose of this status is to make available without charge courses and services of the University's campuses to citizens who are 60 years of age or older, who are residents of the State of Maryland and who are retired (a retired person will be considered one who affirms that he is not engaged in gainful employment for more than 20 hours per week). People meeting these requirements may apply for graduate admission, either as degree or nondegree students, and must meet the same admissions criteria pertaining to either category as do all applicants. Once admitted and having been issued the Golden Identification Card, such persons may register for courses in any session, subject to the same restrictions as any other student, and use the library and other campus facilities during the time they are enrolled in courses. Tuition fees will be waived for holders of the Golden Identification Card.

Veterans Benefits

Recent federal legislation has had significant impact on the veteran-graduate student. People who originally were entitled to 36 months of V.A. Educational Benefits now have a total of 45 months of educational benefits. The new complement of benefits can be used for graduate work.

See the Veterans Section of the current *Schedule of Classes* for other current information.

Veterans Administration counselors work on campus full-time to assist veterans, their dependents, and servicemen with all V.A. related questions and problems. These representatives can offer you help in getting your monthly educational assistance checks, as well as other less known but available benefits. Some of these are compensation for service connected disabilities, guaranteed home loans, and vocational rehabilitation services for disabled veterans.

Related information, such as facts on individual state bonuses, removal of derogatory SPN codes from your military discharge (DD214), and University of Maryland Veterans Club activities, is also available.

The counselors are available on a walk-in-basis during normal office hours in Room 1130 North Administration Building. Telephone 454–5276.

Student Services

Housing

There is no on-campus housing provided for unmarried graduate students. The Off-Campus Housing Office (Room 1295, Student Union, 454–3645), in cooperation with many of the local landlords and apartment managers, maintains an extensive and up-to-date list of vacancies under several headings (Rooms, Unfurnished Apartments, Houses to Share, etc.). This office can also provide students with convenient maps of the College Park area and with lists of local motels, trailer and mobile home parks, real estate agents, and furniture rental companies.

Current rates for housing in the area are about $125–$175 per month for a room in a private home, $250–$350 per month for an efficiency or one bedroom apartment; $100–$175/month for a shared apartment, and $450–$550/month for a two-bedroom house.

The University itself maintains two apartment complexes for married graduate students and for a limited number of single graduate students. Both Lord Calvert Apartments and University Hills Apartments are within walking distance of campus, which means that there is usually a waiting list, especially during the period immediately preceding the fall semester. Priority for housing in these complexes is currently given to married full-time graduate assistants, then married full-time graduate non-assistants.

Rent for a one-bedroom apartment is $189–$199/month, with two-bedroom apartments costing about twenty-five dollars more; a limited number of efficiencies are available to single students for a slightly lower monthly rent. Students must sign a one year lease and pay a security deposit of $100 (payable when the applicant's name is added to the waiting list). There is a nonrefundable application fee of $10 for adding a name to the waiting list. After the initial lease expires, residence in the apartments is on a monthly basis. Graduate students who maintain full-time status are permitted to live in the apartments for a *maximum of five years.*

Information and applications for University-owned housing can be obtained from the Rental Office, 3424 Tulane Drive, Hyattsville, Maryland 20783 (422–7445).

University Food Services

The University Food Service offers four dining contract options which are available to graduate students. The options and their costs on a semester basis for 1979–1980 were any 19 meals per week for $469.00; any 15 meals per week for $436.50; any 10 meals per week for $415.50; and any 5 meals per week for $258.50. Increases in these prices are anticipated for 1980–81. University people can obtain guest meal tickets for individual meals in contract dining halls for fairly reasonable prices (unlimited quantities for $2.35 at breakfast, $3.00 at lunch, and $3.50 at dinner). More information about contract dining can be obtained from Mr. John Goecker (454–2901).

In addition to the services offered by the contract dining halls, graduate students may wish to take advantage of the cash line services available at the Hill Dining Hall or the various restaurants and snack bars at the Student Union.

Hillel Kosher Dining Club, housed in Hillel House, 7505 Yale Avenue, College Park (779–7370), provides Kosher meals on either a regular or occasional basis.

Career Development Center

The Career Development Center, located in Hornbake Library offers a wide variety of services to graduate students. The goal of the Center is

to assist students in exploring career opportunities and planning their careers. Services include career advising, the Career Library, the credentials service, and the on-campus interview program.

The career advising program includes both individual and group advising sessions and workshops on jobseeking skills, resume preparation, and interviewing skills. The Career Library contains occupational information, full-time job listings, employer directories, and other reference sources.

Graduate students are eligible to participate in the on-campus interview program, which involves campus visits by representatives from business, government, and education. Students interested in employment in the fields of education and library science will find the credentials service especially valuable.

Certain services of the Center are also available to students' spouses.

Counseling Center

The Counseling Center offers consultation on education/psychological concerns; an open educational-vocational information library; recorded interviews with department heads on the characteristics of graduate majors offered on the campus; and a weekly Research and Data series of presentations on current educational/psychological topics.

Available services include the following: the Counseling Service, which offers initial consultation on any problems and provides further counseling services or referral services to appropriate individuals or agencies in the area; the Reading and Study Skills Laboratory, for those interested in improving any of their educational skills including special assistance for students for whom English is a second language; the Parent Consultation and Child Evaluation Service, providing a variety of services to the parents of young children with learning or behavior problems; and the Testing, Research and Data Processing Division, which serves as the testing and census taking arm of the campus.

The Center provides consultation to a variety of groups and individuals concerning organizational development and group productivity. Other programs include a series of self-understanding and development groups for interested students and staff.

The Center provides a wide variety of research reports on characteristics of students and campus environment.

National testing programs (GRE, Miller Analogies, etc.) are administered by the Counseling Center as well as testing for counseling purposes. Office location; Shoemaker Building. Telephone: Counseling Services 454–2931; Reading and Study Skills Lab 454–2935.

Health Care

The University Health Center is located on Campus Drive directly across from the Student Union. Both graduate and undergraduate students are eligible for health care at the Health Center. Services provided include both emergency and routine medical care, mental health evaluation and treatment, health education, laboratory, x-ray, gynecological services, and upon referral from a Health Center physician, dermatological services and orthopedic services.

Students requiring service should call the Health Center for an appointment. Students who are injured or are too ill to wait for an appointment will be seen on a walk-in basis. Emergencies always receive highest priority.

The Health Center is open 8:00 a.m.–8:00 p.m. weekdays and 11:00 a.m.–3:00 p.m. on weekends with acute illnesses taking priority on evenings and weekends. People with emergencies are seen 24 hours a day.

Upon payment of the health fee registration, a student becomes eligible for routine medical care and professional services at the Health Center. Charges however, are made for certain laboratory tests, all x-rays, casts and allergy injections. It should be noted that the mandatory health fee is not a form of health insurance. For information and emergencies, call 454–3444; Appointments, 454–4923; Mental Health, 454–4925; Women's Health, 454–4923; Health Education, 454–4922.

Health Insurance

Because the mandatory health fee is not a form of health insurance and many students do not have adequate coverage, a voluntary group insurance policy is available to students. This policy provides benefits, at very reasonable rates, for hospital, surgery, emergency, laboratory, and x-ray purposes; some coverage for mental and nervous problems; and contains a major hospital provision. Students may enroll at mid-year for a half-yearly rate, and they may elect to have family coverage. Enrollment periods for the policy are August 15-October 1 and January 1-March 1. For additional information and application forms, see the brochure available in the Health Center or in the Office of Student Affairs.

Publications of Interest to Graduate Students

In addition to the Catalog, the Graduate School prepares the following publications:

Graduate Application Booklet: This booklet, which contains the application forms and information you need to complete the forms, is available on request from the Graduate School Mailing Office or from the individual departments.

Graduate Bulletin: The *Bulletin* is for prospective students and provides information on campus and area libraries, research facilities, and cultural opportunities; descriptions of individual programs; and a list of titles of courses offered at UMCP. It also contains the application forms and instructions for completing them.

Guide to Graduate Life. This handbook, designed to provide the new graduate student with an introduction to the campus and the College Park area, is available from the office of the Dean for Graduate Studies and Research.

Graduate Assistant Handbook. This handbook sets forth policies, procedures, and services of interest to graduate assistants and is available from the departmental graduate offices and the office of the Dean for Graduate Studies and Research.

Graduate Student Academic Handbook. This manual contains the instructions for preparation of theses and dissertations and is available at a nominal cost from the University book store.

Important Dates for Advisors and Students. This calendar card of dates for submission of final documents is available from the various departmental graduate offices, as well as from the office of the Dean for Graduate Studies and Research.

Code of Student Conduct

A Code of Student Conduct was adopted by the Board of Regents on January 25, 1980, and is applicable to both graduate and undergraduate students. The Code is reproduced in the *Undergraduate Catalog* and is available in the Office of the Dean for Graduate Studies and Research and in the Office of Judicial Programs.

University Policy on Disclosure of Student Records

(Buckley Amendment)

The University of Maryland adheres to a policy of compliance with the Family Educational Rights and Privacy Act (Buckely Amendment). As such, it is the policy of the University (1) to permit students to inspect their education records, (2) to limit disclosure to others of personally identifiable information from education records without students' prior written consent, and (3) to provide students the opportunity to seek correction of their education records where appropriate.

I. Definitions
   A. "Student" means an individual who is or who has been in attendance at the University of Maryland. It does not include any applicant for admission to the University who does not matriculate, even if he or she previously attended the University. (Please note, however, that such an applicant would be considered a "student" with respect to his or her records relating to that previous attendance.)
   B. "Education records" include those records which contain information directly related to a student and which are maintained as official working files by the University. The following are not educational records:
      (1) records about students made by professors and administrators for their own use and not shown to others;
      (2) campus police records maintained solely for law enforcement purposes and kept separate from the education records described above;
      (3) employment records, except where a currently enrolled student is employed as a result of his or her status as a student;
      (4) records of a physician, psychologist, or other recognized professional or paraprofessional made or used only for treatment purposes and available only to persons providing

treatment. However, these records may be reviewed by an appropriate professional of the student's choice;

(5) records which contain only information relating to a person's activities after that person is no longer a student at the University.

II. It is the policy of the University of Maryland to permit students to inspect their education records.

A. **Right of Access**

Each student has a right of access to his or her education records, except confidential letters of recommendation received prior to January 1, 1975, and financial records of the student's parents.

B. **Waiver**

A student may, by a signed writing, waive his or her rights of access to confidential recommendations in three areas: admission to an educational institution, job placement, and receipt of honors and awards. The University will not require such waivers as a condition for admission or receipt of any service or benefit normally provided to students. If the student chooses to waive his or her right of access, he or she will be notified, upon written request, of the names of all persons making confidential recommendations. Such recommendations will be used only for the purpose for which they were specifically intended. A waiver may be revoked in writing at any time, and the revocation will apply to all subsequent recommendations, but not to recommendations received while the waiver was in effect.

C. **Types and Locations of Education Records, Titles of Records Custodians**

Please note that all requests for access to records should be routed through the Registrations Office (see II. D. below).

(1) **Admissions**

Applications and transcripts from institutions previously attended.

a. Undergraduate—Director of Undergraduate Admissions, North Administration.

b. Graduate—Director of Graduate Records, South Administration

(2) **Registrations**

All on-going academic and biographical records. Graduate and Undergraduate—Director of Registrations, North Administration.

(3) **Departments**

Departmental offices; Chairman (Check first with the Director of Registrations.) (Miscellaneous records kept vary with the department.)

(4) **Deans and Provosts**

Deans and Provosts offices of each school. Miscellaneous records.

(5) **Resident Life**

North Administration, Director of Resident Life Student's housing records.

(6) **Advisors**

Pre-law Advisor: Undergraduate Library Pre-Dental Advisor: Turner Laboratory Pre-Medical Advisor: Turner Laboratory Letters of evaluation, personal information sheet, transcript, test scores (if student permits).

(7) **Judicial Affairs**

North Administration Building, Director of Judicial Affairs. Students' judicial and disciplinary records.

(8) **Counseling Center**

Shoemaker Hall, Director.

Biographical data, summaries of conversations with student, test results. (Where records are made and used only for treatment purposes, they are not education records and are not subject to this policy.)

(9) **Financial Aid**

a. Undergraduate—North Administration, Director of Financial Aid.

b. Graduate and Professional Schools—Located in Dean's Offices.

Financial aid applications, need analysis statements, awards made (no student access to parents' confidential statements).

(10) **Career Development Center**

Terrapin Hall, Director. Recommendations, copies of academic records, (unofficial) (note WAIVER section).

(11) **Business Services**

South Administration Building, Director. All student accounts receivable, records of students' financial charges, and credits with the University.

D. **Procedure to be Followed**

Requests for access should be made in writing to the Office of Registrations. The University will comply with a request for access within a reasonable time, at least within 45 days. In the usual case, arrangements will be made for the student to read his or her records in the presence of a staff member. If facilities permit, a student may ordinarily obtain copies of his or her records by paying reproduction costs. The fee for copies is $.25 per page. No campus will provide copies of any transcripts in the student's records other than the student's current University transcript from that campus. Official University transcripts (with University seal) will be provided at a higher charge.

III. It is the policy of the University of Maryland to limit disclosure of personally identifiable information from education records unless it has the student's prior written consent, subject to the following limitations and exclusions.

A. **Directory Information**

(1) The following categories of information have been designated directory information:

Name
Address
Telephone listing
Date and place of birth
Photograph
Major field of study
Participation in officially recognized activities and sports
Weight and height of members of athletic teams
Dates of attendance
Degrees and awards received
Most recent previous educational institution attended

(2) This information will be disclosed even in the absence of consent unless the student files written notice informing the University not to disclose any or all of the categories within three weeks of the first day of the semester in which the student begins each school year. This notice must be filed annually within the above alloted time to avoid automatic disclosure of directory information. The notice should be filed with the campus registrations office. See II. C.

(2) The University will give annual public notice to students of the categories of information designated as directory information.

(4) Directory information may appear in public documents and otherwise be disclosed without student consent unless the student objects as provided above.

B. **Prior Consent not Required**

Prior consent will not be required for disclosure of education records to the following parties:

(1) School officials of the University of Maryland who have been determined to have legitimate educational interests;

a. "School officials" include instructional or administrative personnel who are or may be in a position to use the information in furtherance of a legitimate objective;

b. "legitimate educational interests" include those interests directly related to the academic environment;

(2) Officials of other schools in which a student seeks or intends to enroll or is enrolled. Upon request, and at his or her expense, the student will be provided with a copy of the records which have been transferred;

(3) Authorized representatives of the Comptroller General of the U.S., the Secretary of HEW, the Commissioner of the Office of Education, the Director of the National Institute of Education, the Administrator of the Veterans' Administration, the Assistant Secretary of HEW for Education, and State educational authorities, but only in connection with the audit or evaluation of federally supported education programs, or in connection with the enforcement of or compliance with federal legal requirements relating to these programs. Subject to controlling Federal law or prior consent, these officials will protect information received so as not to permit personal identification of students to outsiders;

(4) Authorized persons and organizations which are given work in connection with a student's application for, or receipt of, financial aid, but only to the extent necessary for such purposes as determining eligibility, amount, conditions and enforcement of terms and conditions;

(5) State and local officials to which such information is specifically required to be reported by effective state law adopted prior to November 19, 1974;

(6) Organizations conducting educational studies for the purposes of developing, validating, or administering predictive tests, administering student aid programs, and improving instruction. The studies shall be conducted so as not to

permit personal identification of students to outsiders, and the information will be destroyed when no longer needed for these purposes;

(7) Accrediting organizations for purposes necessary to carry out their functions;

(8) Parents of a student who is a dependent for income tax purposes. (Note: The University may require documentation of dependent status such as copies of income tax forms.)

(9) Appropriate parties in connection with an emergency, where knowledge of the information is necessary to protect the health or safety of the student or other individuals;

(10) In response to a court order or subpoena. The University will make reasonable efforts to notify the student before complying with the court order.

C. **Prior Consent Required**
In all other cases, the University will not release personally identifiable information in education records or allow access to those records without prior consent of the student. Unless disclosure is to the student himself or herself, the consent must be written, signed, and dated, and must specify the records to be disclosed, the identity of the recipient, and the purpose of disclosure. A copy of the records disclosed will be provided to the student upon request and at his or her expense.

D. **Record of Disclosures**
The University will maintain with the student's education records a record for each request and each disclosure, except for the following:

(1) disclosures to the student himself or herself;l

(2) disclosures pursuant to the written consent of the student (the written consent itself will suffice as a record);

(3) disclosures to instructional or administrative officials of the University;

(4) disclosures of directory information.
This record of disclosures may be inspected by the student, the official custodian of the records, and other University and governmental officials.

IV. It is the policy of the University of Maryland to provide students the opportunity to seek correction of their education records.

A. **Request to Correct Records**
A student who believes that information contained in his or her education records is inaccurate, misleading, or violative of privacy or other rights may submit a written request to the Office of Registrations specifying the document(s) being challenged and the basis for the complaint. The request will be sent to the person responsible for any amendments to the record in question. Within a reasonable period of time of receipt of the request, the University will decide whether to amend the records in accordance with the request. If the decision is to refuse to amend, the student will be so notified and will be advised of the right to a hearing. He or she may then exercise that right by written request to the Office of the Chancellor.

B. **Right to a Hearing**
Upon request by a student, the University will provide an opportunity for a hearing to challenge the content of the student's records. A request for a hearing should be in writing and submitted to the Office of Registrations. Within a reasonable time of receipt of the request, the student will be notified in writing of the date, place, and time reasonably in advance of the hearing.

(1) **Conduct of the hearing**
The hearing will be conducted by a University official who does not have a direct interest in the outcome. The student will have a full and fair opportunity to present evidence relevant to the issues raised and may be assisted or represented by individuals of his or her choice at his or her expense, including an attorney.

(2) **Decision**
Within a reasonable period of time after the conclusion of the hearing, the University will notify the student in writing of its decision. The decision will be based solely upon evidence presented at the hearing and will include a summary of the evidence and the reasons for the decision. If the University decides that the information is inaccurate, misleading, or otherwise in violation of the privacy or other rights of students, the University will amend the records accordingly.

C. **Right to Place an Explanation in the Records**
If, as a result of the hearing, the University decides that the information is not inaccurate, misleading, or otherwise in violation of the student's rights, the University will inform the student of the right to place in his or her record a statement commenting on the information and/or explaining any reasons for disagreeing with the University's decision. Any such explanation will be kept as part of the student's record as long as the contested portion of the record is kept and will be disclosed whenever the contested portion of the record is disclosed.

V. **Right to File Complaint**
A student alleging University noncompliance with the Family Educational Rights and Privacy Act may file a written complaint with the Family Educational Rights and Privacy Act Office (FERPA), Department of HEW, 330 Independence Avenue, S.W., Washington, D.C. 20201.

Admission to Graduate School

Graduate Programs

Programs	*Degrees Offered*
Administration, Supervision and Curriculum[6]	M.Ed., M.A., A.G.S., Ed.D., Ph.D.
Aerospace Engineering	M.S.*, Ph.D.
Agricultural and Extension Education[2]	M.S.*, A.G.S., Ph.D.
Agricultural and Resource Economics[3]	M.S.*, Ph.D.
Agricultual Engineering	M.S.*, Ph.D.
Agronomy	M.S.*, Ph.D.
American Studies[3]	M.A.*, Ph.D.
Animal Sciences[3]	M.S.*, Ph.D.
Applied Mathematics	M.A.*, Ph.D.
Architecture[5]	M.Arch.
Art	M.A.*, M.F.A., Ph.D.
Astronomy[4]	M.S.*, Ph.D.
Biochemistry	M.S.*, Ph.D.
Botany[3]	M.S., Ph.D.
Business and Management[1]	M.S., M.B.A.[8], D.B.A.
Chemical Engineering	M.S.* Ph.D.
Chemical Physics	M.S.,* Ph.D.
Chemistry	M.S.*, Ph.D.
Civil Engineering	M.S.,* Ph.D.
Communication Arts and Theatre[3]	M.A.*
Comparative Literature	M.A.*, Ph.D.
Computer Science[5]	M.S.*, Ph.D.
Counseling and Personnel Services[2]	M.Ed., M.A., A.G.S., Ph.D.
Criminal Justice and Criminology[3]	M.A.*, Ph.D.
Early Childhood-Elementary Education[2]	M.Ed., M.A. A.G.S., Ed.D., Ph.D.
Economics[3]	M.A.*, Ph.D.
Electrical Engineering	M.S.*, Ph.D.
Engineering Materials	M.S.*, Ph.D.
English Language and Literature	M.A.*, Ph.D.
Entomology[3]	M.S.*, Ph.D.
Family and Community Development[3]	M.S.*
Food, Nutrition and Institution Administration[3]	M.S.*
Food Science[3]	M.S.*, Ph.D.
French Language and Literature[5]	M.A.*, Ph.D.
Geography[3]	M.A.*, Ph.D.
Germanic Language and Literature	M.A.*, Ph.D.
Government and Politics[3]	M.A.*, Ph.D.
Health Education[3]	M.A.*, Ph.D.
Hearing and Speech Sciences[3]	M.A.*, Ph.D.
History[3]	M.A.[7], *Ph.D.
Horticulture[3]	M.S.*, Ph.D.
Human Development Education[2]	M.Ed., M.A., A.G.S., Ed.D., Ph.D.
Industrial Education[2]	M.Ed., M.A.*, A.G.S., Ed.D., Ph.D.
Journalism[3]	M.A.*
Library and Information Services[3]	M.L.S.[7], Ph.D.
Marine-Estuarine-Environmental Science[3]	M.S., Ph.D.
Mathematical Statistics	M.A.*, Ph.D.
Mathematics	M.A.*, Ph.D.
Measurement and Statistics[3]	M.Ed., M.A.*, A.G.S., Ed.D., Ph.D.
Mechanical Engineering	M.S.*, Ph.D.
Meteorology	M.S.*, Ph.D.
Microbiology[5]	M.S., Ph.D.
Music[5]	M.M., D.M.A., Ph.D.
Nuclear Engineering	M.S.*, Ph.D.
Nutritional Sciences	M.S.*, Ph.D.
Philosophy[3]	M.A.*, Ph.D.
Physical Education[3]	M.A.*, Ph.D.
Physics[4]	M.S.*, Ph.D.
Poultry Science	M.S., Ph.D.
Psychology[5]	M.A., M.S., Ph.D.
Public Communication[3]	Ph.D.

Recreation[3]	M.A., Ed.D., Ph.D.
Secondary Education[2]	M.Ed., M.A.*, A.G.S. Ed.D., Ph.D.
Social Foundations of Education[2]	M.A.*, Ph.D.
Sociology[3]	M.A., Ph.D.
Spanish Language and Literature	M.A.*, Ph.D.
Special Education[2]	M.Ed., M.A., A.G.S., Ed.D., Ph.D.
Textiles and Consumer Economics[3]	M.S.*, Ph.D.
Urban Studies[5]	M.A.*
Zoology	M.S.*, Ph.D.

[1]GMAT (Graduate Management & Admissions Test)
[2]Miller Analogies Test required for admission.
[3]Graduate Record Examination Aptitude Test required.
[4]Graduate Record Examination Advanced Test required.
[5]Both Aptitude and Advanced Graduate Record Examinations required.
[6]Either the GRE Aptitude or the Miller Analogies Test is required.
[7]History and Library and Information Services offer a directed course of study leading to both the M.A. and M.L.S. degrees.
[8]The College of Business and Management offers a joint program with the Law School of the University of Maryland at Baltimore leading to both the M.B.A. and J.D. degrees
*Non-thesis option available for M.A. or M.S

For further details on entrance examinations see Admission to Graduate School below.

Administrative Offices

The administrative offices of the Graduate School are located on the second floor of the South Administration Building, and the Dean, Associate Deans, and Assistant Dean for Graduate Studies and Research and their staff may be found in Suite 2133. Other offices to which students may go for administrative assistance are listed below:

Office of the Director of Graduate Records: Room 2125, South Administration Building. The Director of Records of the Graduate School is the person in charge of graduate admissions and records of degree progress for all prospective and admitted students.

Office of Graduate Admissions: Room 2107, South Administration Building. This office receives and maintains all files of students applying for admission and answers all inquiries regarding the admission process.

Office of Graduate Records: Room 2117, South Administration Building. This office maintains all files for graduate students after they have been admitted and provides information on registration procedures. Students may obtain the "Continuous Registration Form" and the "Intercampus Enrollment Form" here, and petitions and information on in-state classification for tuition and charge-differential purposes are handled by this office.

Fellowships and Finance Office: Room 2126, South Administration Building. The Fellowships and Finance Office serves as a clearinghouse for information on available fellowships which are sponsored by the Graduate School.

Office of the Assistant to the Dean: Room 2114, South Administration Building. The Assistant to the Dean is generally responsible for assuring that the academic programs and accomplishments of graduate students fulfill the requirements for degrees established by the Graduate Council. The following forms are received and processed by this office: 1. "Doctoral Candidacy Forms"; 2. "Request for Appointment of Doctoral Examining Committee"; 3. "Master's Approved Program Form"; 4. "Certification of Completion of Non-thesis Master's Option"; 5. "Certification of Completion of the Master's Thesis." It is to this office that copies of the thesis and dissertation must be submitted, and it is the Assistant to the Dean who prepares official commencement lists. In addition, students submit to this office registration forms for foreign language examinations and requests for approval of transfer of credit for the Masters' programs.

General

Responsibility for admitting applicants to graduate programs rests with the Dean and his staff, who regularly seek the advice of the chairmen and graduate admission committees of the academic programs in making their decisions. In the case of foreign student applicants, the University's Director of International Education Services is also consulted. Standards applied by the Graduate School and individual programs are to insure that students admitted have high qualifications and a reasonable expectation of successfully completing a graduate program. Standards for admission to doctoral programs are frequently higher than those for admission to master's programs. In many degree programs applications by qualified students for admission to graduate study regularly exceed the number of students who can be accommodated. In order to maintain programs of outstanding quality, the number of spaces in each program is limited according to the availability of faculty, special resources, and funds for students requiring financial assistance. The Graduate School admits the most highly qualified applicants up to the limit of the number of spaces in each program.

Criteria for Admission

The decision to admit an applicant to a program is based primarily on results from a combination of the following criteria according to requirements of the specific program or department.

Quality of previous undergraduate and graduate work. The Graduate School requires as a minimum standard a B average or 3.0 on a 4.0 scale, in a program of study resulting in the award of a baccalaureate degree from a regionally accredited college or university. In addition, the student's undergraduate program should include completion of the prerequisites for graduate study in his chosen field. In individual programs, where resources are available, a few applicants who do not meet this minimum standard for undergraduate work may be provisionally admitted if there is compelling evidence on the basis of other criteria of a reasonable likelihood of success in the program the person desires to enter. If an applicant has studied at the graduate level elsewhere less weight may be, but is not necessarily, placed on the quality of the undergraduate academic record. Some programs may require a higher minimum grade average for admission.

2. **Strength of letters of recommendation from persons competent to judge the applicant's probable success in graduate school.** Usually these letters are from the applicant's former professors who are able to give an in-depth evaluation of the applicant's strengths and weaknesses with respect to academic work. Additional recommendations may come from employers or supervisors who are familiar with the applicant's work experience. Applicants should instruct their references to send all letters of recommendation directly to the program in which they desire entrance. Some departments do not require letters of recommendation. (See application form.)

3. Scores on a nationally standardized examination. Because the predictive utility of these scores may vary from one group of applicants to another, a discriminating use of all relevant materials will be made in each applicant's case. The three most widely used standardized examinations are the Graduate Record Examinations, Graduate Management Admissions Test, and the Miller Analogies Test.

Although many graduate programs do not require the GRE, almost all will use such test scores as an additional measure of an applicant's qualifications. The GRE may be taken in either or both of two forms: The Aptitude Test and The Advanced Test. Applicants can take this test in their senior year or when filing for admission. For details, applicants should write directly to Graduate Record Examinations, Educational Testing Service, Box 955, Princeton, New Jersey 08540.

GRADUATE MANAGEMENT ADMISSIONS TEST (GMAT): Details about this test, required when applying to a program in Business and Management, can be obtained by writing to the Educational Testing Service, Box 966, Princeton, N.J., 08540.

THE MILLER ANALOGIES TEST (MAT): Details about the graduate form of this test can be obtained by writing to the Director, Counseling Center, University of Maryland, College Park, Md. 20742.

For information on the programs requiring one of these tests, please see the List of Graduate Programs in this catalog and the instructions accompanying application forms.

4. **Statement by the applicant of his academic career objectives and their relation to the program of study he wishes to pursue.** These statements help the department or program identify students whose objectives are consonant with the objectives of the program.
5. **Other evidence of graduate potential.** Some programs require other evidence of graduate potential, such as samples from portfolios of creative work, completion of specialized examinations, or personal interviews.

In addition to the above criteria, special consideration will be given to:

1. **Residence of the applicant.** While the University desires to maintain a geographically diverse graduate student population, it also recognizes its responsibility to legal residents of the state. Every effort will be made to accommodate qualified Maryland residents.
2. **Sex and minority group membership.** The University of Maryland, its Graduate School and each of its academic components have strong affirmative action programs for increasing the participation of minority groups and women among its students, staff and faculty.

Categories of Admission to Degree Programs

Full Graduate Status
For admission in this category an applicant must have received a baccalaureate degree from a regionally accredited institution and be otherwise fully qualified in every respect.

Provisional Graduate Status
This designation may be used when 1) the quality of the previous academic record at a regionally accredited institution is lower than established standards or when there is a lack of adequate prerequisite course work in the chosen field; 2) when the applicant has majored in another area with a creditable record but there is some doubt about his ability to pursue the program of study in question; 3) when the applicant is engaged in graduate study at another institution but is not able to furnish a transcript indicating completion of course work or degree requirements; or 4) when the applicant is a senior in his final semester of work for a bachelor's degree and is not able to furnish a final transcript indicating the completion of all requirements and the award of the degree.

Students admitted provisionally because of incomplete official supporting documents must have a complete official record of all previous work sent to the Graduate School within three months following the completion of such study and the award of the degree, or they face cancellation of admission.

A program to correct any deficiencies in preparation will be outlined by the faculty, and the student is expected to become fully qualified within a specified time limit. When all conditions have been met, the department may recommend admission of the student to full status. Students who are unable to qualify for full admission under the conditions specified may have their admission terminated.

Non-degree Admission Categories

Advanced Graduate Specialist Certificate Status
The Advanced Graduate Specialist program is designed to promote a high level of professional competence in an area of specialization in the field of education. The candidate must be able to show that he or she can operate as an effective counselor, administrator, teacher or skilled person in a major field of professional endeavor. The Advanced Graduate Specialist Certificate is offered through most of the programs in the College of Education and the Agricultural and Extension Education program in the College of Agriculture. The Certificate is awarded by the College of Education or by the College of Agriculture. Requirements are as follows:

1. Applicants must meet the same general criteria for admission as are prescribed for degree seekers. Additionally, the applicant must have completed a master's degree or the equivalent in credits earned either at the University of Maryland or at another regionally accredited institution. The Miller Analogies Test scores are required at the time of application.
2. Coursework totaling not more than 30 credits with grades of at least a "B" from an accredited institution may be transferred to the program at the University of Maryland.
3. The program must be developed in cooperation with an advisor and filed with the Graduate Studies office in the College of Education.
4. The Advanced Graduate Specialist Certificate program requires a minimum of 60 semester hours of credit with not less than 30 semester hours of credit completed with the University of Maryland. At least one half of the credits earned either at other institutions or at the University of Maryland must be in courses comparable to those in the 600–800 series. The student may be required to take a substantial portion of the program in departments other than those in the College of Education or the College of Agriculture. Registration in certain kinds of field study, field experience, apprenticeship or internship may also be required.
5. There will be a written examination of not less than six hours. A "B" average with no "D" or "F" grades will be required before the certificate can be awarded.

For additional details see "Statement of Policies and Procedures; Advanced Graduate Specialist Program in Education," issued by the College of Education.

Advanced Special Student Status
The Advanced Special Student Status is designed to provide an opportunity to individuals who do not have an immediate degree objective in mind to take graduate level courses. Although the primary mission of the Graduate School is to conduct programs of graduate instruction leading to advanced degrees, the Graduate Faculty welcomes, to the extent that available resources allow, qualified students who have no degree objectives.

Applicants for admission to Advanced Special Student Status must satisfy at *least one* of the following criteria:

1. Hold a baccalaureate degree from a regionally accredited institution with an overall "B" (3.0) average. Applicants must submit official transcripts covering all credits used in satisfying the baccalaureate degree requirements.
2. Hold a master's or doctoral degree from a regionally accredited institution. Applicants must submit an official transcript showing the award of a master's or doctoral degree.
3. Hold a baccalaureate degree from a regionally accredited institution and have at least four years of successful post-baccalaureate work or professional experience. Applicants must submit an official transcript showing the award of the baccalaureate degree and a signed statement summarizing successful post-baccalaureate work or professional experience. Letters from employers or professional organizations to support the statement of successful professional experiences are also required.
4. Achieve a score that places the applicant in the upper 50 percentile of appropriate national standardized aptitude examinations such as the Graduate Record Examination Aptitude Test, the Miller's Analogies Test, the Graduate Management Admissions Test. Where different percentiles are possible, the Graduate School will determine which score is acceptable.

Admission to Advanced Special Student status will continue for five years. If there is no registration in three consecutive academic year semesters, the admitted status will lapse, after which a new application will be required.

Advanced Special Students must maintain a 2.75 grade point average.

Advanced Special Students must pay all standard graduate fees. Students in this status are not eligible to hold appointments as Graduate Teaching or Research Assistants or Fellows. All other services, e.g., parking, library privileges, etc., are the same as those accorded to other graduate students.

Admission to Advanced Special Student status is not intended to be used as a preparatory program for later admission to a doctoral or master's program nor to the Advanced Graduate Specialist Certificate program. Credits earned while in this status may be applicable to a degree or certificate program at a later time only with the approval of the faculty in the desired program, if the student is subsequently accepted for degree or certificate study. For consideration of admission to a degree program at a later time, the student must submit an application in the standard format, with a new application fee, to the Graduate School.

Visiting Graduate Student Status Graduate Student, Visiting
A graduate student matriculated in another graduate school, who wishes to enroll in the Graduate School of the University of Maryland at College Park and who intends thereafter to return to the graduate school in which he is matriculated, may be admitted as a Visiting Graduate Student.

Criteria for enrollment as a visitor are admission to and good standing in another recognized graduate school. The applicant need not submit full transcripts of credits, but he must apply for admission to the UMCP Graduate School and pay the application fee. In lieu of transcripts, a student may have his own graduate dean certify, in writing, to the Graduate School that he is in good standing and that the credits will be accepted toward his graduate degree. Unless otherwise specified, admission will be offered for one year only.

Non-degree Student Status-Undergraduate
This is an undergraduate classification and may be assigned by the Director of Admissions (undergraduate division) to those applicants who have received the baccalaureate or an advanced degree from a regionally accredited institution but who do not desire or who do not qualify for graduate admission. Non-degree seeking students who do not have a baccalaureate degree or an R.N. must submit transcripts and meet regular admission standards. Transcripts are not required from students with baccalaureate degrees or an R.N.

Application for Non-degree Student Status—Undergraduate must be made directly to the Office of Admissions, not to the Graduate School.

Students often need permission from the deans of the various schools and colleges of the university to enroll as a Non-degree Student. Non-degree Students may enroll for courses through the 500 numbered series for which they possess the necessary prerequisites. Courses numbered 600 or above are intended for admitted graduate students only.

The student is warned that no credit earned while in a Non-degree Student Status—Undergraduate may be applied at a later date to a degree program.

Offer of Admission

A written offer of admission is made to all accepted applicants and specifies the date of entrance, which will normally coincide with the date

requested in the application. The student must accept or decline the offer of admission by the date indicated in the offer, or it lapses and the space is reassigned to another applicant. An individual whose offer of admission has lapsed must submit a new application and fee, if he wants to be reconsidered for admission at a later date.

The *offer of admission is also a permit-to-register for courses* and must be presented by the student at the time of his first registration. Identification as a graduate student, to be used thereafter, will be issued at the time of first registration.

Admission Time Limits

For master's degree candidates, Advanced Graduate Specialist Certificate seekers, and Advanced Special Students, admission terminates five years from the entrance date. Visiting Graduate Students and NSF Institute students are admitted for specified periods.

A doctoral student must be admitted to candidacy within five years after entrance and must complete all remaining requirements within four years after admission to candidacy. Admission to the doctoral program terminates if these conditions are not met.

Change of Objective, Status Termination of Admission

Students are admitted only to a specified program and within that program only for the specified objective: e.g., master's degree, doctoral degree, or Advanced Graduate Specialist Certificate. If the student wishes to change either the program or his status (for example, from Advanced Special Student to degree status), he must submit a new application and fee for admission. Admission in the new status is not granted automatically.

The student's admission also terminates when the original objective has been attained; for example, the admission terminates when a student who is admitted for the master's degree completes the requirements for that degree. If the student wishes to continue for the doctorate, a new application for admission to the doctoral program must be submitted; requests for admission to the doctoral program are subject to the same review process applied to others seeking admission to that program.

A student can be admitted to only one graduate program at any one time. Application for and acceptance of an offer of admission in a second graduate program automatically terminates the student's admission to the first program.

Students must maintain an average grade of B or better in all graduate courses taken and must otherwise satisfy all additional departmental and Graduate School program requirements. The admission of all students, both degree and non-degree, is continued at the discretion of the major professor, the department or program director, and the Dean for Graduate Studies and Research.

Admission of Faculty

No member of the faculty employed by the University of Maryland having the rank of Assistant Professor or above is permitted to take work leading to an advanced degree at this institution.

Application Instructions

To apply you must send both the completed application and complete, official transcripts covering all credits earned at any institution, *in duplicate*, to the Office of the Dean for Graduate Studies and Research, University of Maryland, College Park, Maryland 20742.

Decisions on admission and financial aid for either summer terms and for fall semester will first be made for those whose completed applications and supporting material have been received by the Graduate School on or before March 1. Qualified applicants whose completed applications and supporting material are received after March 1, but on or before May 1, will be granted admission and financial aid on a first-come, first-served basis, up to the limits of available space in the program.

Applications for entry for the Spring semesters must be received by November 1.

Application deadlines for non-U.S. citizens—please see "Foreign Student Applications" below.

It is in general to the student's advantage to apply before the deadline, since in many programs, no space will be available to those who apply after March 1 due to heavy demand for admission. Applicants for Maryland or Graduate School Fellowships must submit their applications by February 1.

The application should arrive before the arrival of transcripts and other supporting evidence of preparation, if these materials cannot be attached to the application.

Applicants are solely responsible for making certain that their transcripts have, in fact, been received by the Graduate School and not by the Registrar's Office or the graduate program desired, since no follow-up action can be taken by the Graduate School.

Students who apply in their senior year in college must have a transcript sent to the Graduate School of all coursework completed up to the time of application. In addition, senior year first semester grade reports should be forwarded, if they are not on the current transcript, since no final decision will be possible without such grades. Seniors should also submit with the application a list of the courses in which they are currently enrolled.

An official transcript is defined as a record which bears the signature of the registrar and the seal of the institution.

A complete and separate application and fee must be submitted for each program in which entrance is sought. A new application is also required if there is a change in the objective or program.

A fee of $15.00 must accompany the application for admission. This fee is not refundable under any circumstances. Payment must be made by check or money order payable to the University of Maryland. Do not send stamps or cash.

Students applying for entrance in either of the two summer sessions are urged to check the *Summer Sessions Bulletin* to determine if the courses they wish to take will be offered in a particular session. To obtain this publication, write to Summer Sessions Office, University of Maryland, College Park, Maryland 20742.

Foreign Student Application

No foreign student seeking admission to the University of Maryland should plan to leave his country before receiving an official offer of admission from the Director of Graduate Records of the Graduate School.

Academic Credentials

The complete application and official academic credentials—beginning with secondary school records—should be received by the Graduate Admissions Office by February 1 for the Fall Semester and by June 1 for the Spring Semester. Space available for foreign students may have been filled prior to this deadline, and all qualified students may not be accepted.

English Proficiency English Proficiency Test

In addition to meeting academic requirements, the foreign student applicant must demonstrate proficiency in English by taking the Test of English as a Foreign language (TOEFL). Because TOEFL is given only six times a year throughout various parts of the world, as soon as a student contemplates study at the University of Maryland, he should make arrangements to take the test. For test information, write to TOEFL Director, Educational Testing Service, Box 899, Princeton, New Jersey 08540. When the applicant is ready to begin his studies, he will be expected to read, speak, and write English fluently, to understand lectures and to take pertinent notes.

Financial Resources

A statement regarding the applicant's financial support is required by the Office of International Education Services. The Office must be assured that an applicant has sufficient financial resources to meet educational and living expenses of approximately $7,400 per year for the entire period of study at the University of Maryland.

Immigration Documents

It is necessary for students eligible for admission to secure from the university's Director of International Education Services the immigration form required for obtaining the appropriate visa. Students already studying in the United States who wish to transfer to the University of Maryland must also secure proper immigration documents to request the Immigration and Naturalization Service to grant permission for transfer.

Reporting Upon Arrival

Every foreign student is expected to report to the Office of International Education Services, North Administration Building, as soon as possible after he arrives at the University. This Office will be able to assist not only with various problems regarding immigration, housing, and fees, but also with problems relating generally to orientation to university and community life.

Questions concerning criteria and requirements for foreign applicants should be addressed to the Director, International Education Services, University of Maryland, College Park, Md. 20742.

Records Maintenance and Disposition

All records, including academic records from other institutions, become part of the official file and can neither be returned nor duplicated for any

purpose. A student should obtain an additional copy of his official credentials to keep in his possession for advisory purposes and for other personal requirements.

The admission credentials and the application data of applicants who do not register for courses at the time for which they have been admitted or whose applications have been disapproved or who do not respond to the departmental requests for additional information or whose applications are not complete with respect to the receipt of all transcripts or test results are retained for 18 months only and then destroyed.

Registration and Credits Registration

Schedule of Classes

Graduate students are expected to be thoroughly familiar with the "Schedule of Classes," a publication issued prior to the beginning of each semester, available in the libraries, the North Administration Building, and the Student Union. The summer session publication, with information on both summer sessions, is available in the Turner Laboratory Summer School Offices. The "Schedule of Classes" lists rules and regulations governing all aspects of registration including deadlines; procedures for dropping or adding a course or making other changes in registration; procedures for the payment of tuition and fees; information about the times and places classes will be offered; and the names of the professors or instructors who will be teaching a particular course or section. It also contains the names, telephone numbers, and office locations of persons who can supply additional information.

Developing a Program

The student is responsible for ascertaining and complying with the rules and procedures of the Graduate School and all applicable department or graduate program requirements which govern the individual program of study.

Registration for the newly admitted graduate student seeking a degree or certificate begins with a visit to the student's academic advisor in the graduate program or department to which the student has been admitted. There the student will obtain information about specific degree or certificate requirements, which supplement those of the Graduate School.

The student will consult the "Schedule of Classes" and will develop, in consultation with a graduate faculty advisor, an individual program of study and research.

Students admitted to Advanced Special Student Status may seek advice from the Dean for Graduate Studies and Research and his staff or from appropriate faculty members.

While most questions normally raised by graduate students, and most problems they meet, will be answered or resolved by the faculty advisor or a departmental committee, the students should remember that the staff of the Graduate School is specifically charged with the responsibility for assisting graduate students who need additional information, guidance, or assistance. Further, the Dean for Graduate Students is the individual to whom requests or petitions for exceptions or waivers of regulations or graduate degree requirements should be addressed and to whom appeals from decisions of departmental or program faculty or administrators should be directed.

Course Numbering System

Courses are designated as follows:

000–099—Non-credit courses.
100–199—Primarily freshman courses.
200–299—Primarily sophomore courses.
300–399—Junior and senior courses not acceptable for credit toward graduate degrees.
400–499—Junior and senior courses acceptable for credit toward some graduate degrees.
500–599—Professional school courses (Dentistry, Law, Medicine) and post-baccalaureate courses not for graduate degree credit.
600–898—Courses restricted to graduate students.
799—Master's thesis credit.
899—Doctoral dissertation credit.

The first character of the numeric position determines the level of the course and the last two digits are used for course identification. Courses ending with an 8 or 9 are courses that are repeatable for credit. All non-repeatable courses must end in 0 through 7.

Graduate credit will not be given unless the student has been admitted to the Graduate School.

Designation of Full and Part-time Graduate Students

In order to accurately reflect the involvement of graduate students in their programs of study and research and the use of University resources in those programs, the Graduate Council uses the graduate unit in making calculations to determine full or part-time student status in the administration of the minimum registration requirements described below and in responding to student requests for certification of full-time student status. The number of graduate units per semester credit hour is calculated in the following manner:

Courses in the series: 000–399 carry 2 units/credit hour.

Courses in the series: 400–499 carry 4 units/credit hour.

Courses in the series: 500–599 carry 5 units/credit hour.

Courses in the series: 600–898 carry 6 units/credit hour.

Research course: 799 carries 12 units/credit hour.

Research course: 899 carries 18 units/credit hour.

To be certified as a full-time student a graduate student must be officially registered for a combination of courses equivalent to 48 units per semester. A graduate assistant holding a regular appointment is a full-time student, if he is registered for at least 24 units in addition to the assistantship.

Grades for Graduate Students

A minimum grade point average of 3.0 is required for graduation with a graduate degree.

Grading Systems
The conventional A through F grading system is used in graduate level courses.

A "Satisfactory or Failure" (S-F) grading system may be used, at the discretion of the department or program, for certain types of graduate study. These include courses which require independent field work, special projects, or independent study. Departmental seminars, workshops, and departmental courses in instructional methods may also be appropriate for the S-F grading system.

The "Pass-Fail" grading system is a grading option for undergraduates. However, in certain cases, a Department or Program may give permission for a graduate student to use the Pass-Fail option for any 100–300 level courses that student takes. Graduate credit may not be earned for these courses.

Thesis and dissertation research, and courses labelled "independent Study" or "Special Problems," may use either the A-F or the S-F grading system.

Only one grading system will be used for a single course in a particular semester. The grading system will be designated by the department or program offering the course.

Computation of Grade Point Average

The A is calculated at 4 quality points, B at 3 quality points and C at 2 quality points. The grades of D, F, and I receive no quality points. After a student is matriculated as a graduate student, all courses he takes numbered 400 and above, except 500-level courses, those numbered 799 or 899, and those graded with an S, will be used in the calculation of the grade point average. A student may repeat any course in an effort to earn a better grade. The later grade, whether higher or lower, will be used in computing the grade point average. Grades for graduate students remain as part of the student's permanent record and may be changed only by the original instructor on certification, approved by the department chairman and the Dean for Graduate Studies and Research, that an actual mistake was made in determining or recording the grade.

No course taken after August 23, 1974, will be considered "not applicable" for the purpose of computing the grade point average of a graduate student. No graduate credit transferred from another institution will be included in the calculation of the grade point average.

Minimum Registration Requirements

All graduate students making any demand upon the academic or support services of the university, whether taking courses, using university libraries, laboratories, computer facilities, office space, housing, or consulting with faculty advisors, taking comprehensive or final oral examinations, must register for the number of graduate units which will, in the judgment of the faculty advisor, accurately reflect the student's

involvement in graduate study and use of university resources. In no case will registration be for less than one credit.

Minimum Registration Requirements for Doctoral Candidates

Doctoral students who have been advanced to candidacy must register each semester, excluding summer sessions, until the degree is awarded.

Dissertation Research
Those who have not completed the required 12 semester credit hours of Dissertation Research (899), or its equivalent, must register for a minimum of 18 graduate units each semester. Doctoral candidates whose demands upon the University are greater than that represented by this minimum registration will, of course, be expected to register for the number of units which reflect their use of University resources.

Continuous Registration
Doctoral candidates who have completed the required minimum of 12 credit hours of Dissertation Research (899), or its equivalent, and who are making *no use* of University resources, must meet a Continuous Registration requirement, in each semester, except for summer sessions, until the degree is awarded. This requirement is met by submitting the Continuous Registration Form and paying the $10.00 Continuous Registration fee, in person or by mail, directly to the Graduate School. Forms and fees must be received before the end of the eighth week of classes during the fall and spring semesters. Continuous Registration forms may be obtained from the Graduate School, Room 2117, South Administration Building, University of Maryland, College Park, Maryland 20742.

Failure to comply with the requirement for maintaining Continuous Registration will be taken as evidence that the student has terminated his doctoral program, and admitted status to the Graduate School will be terminated. A new application for admission, with the consequent reevaluation of the student's performance, will be required of a student wishing to resume a graduate program, whose admission has been terminated under this regulation.

Partial Credit Course Registration for Handicapped Students

The Graduate School recognizes that physically handicapped students may derive considerable educational benefit from courses which include laboratories or other non-classroom activities in which the student is prevented from participating because of the handicap. It is, therefore, the policy of the Graduate School to allow handicapped students to enroll in such courses, complete only those parts of the course that their physical capabilities permit, and receive credit for the course proportionate to their levels of participation.

Physically handicapped graduate students wishing to enroll in such courses but participate only in certain aspects of them, should consult the Assistant to the Dean in the Graduate School (Room 2114 South Administration Building). That person will assist the student in making the necessary arrangements with the department offering the course, the department supervising the student's graduate program, and the Registration Office. The final agreement as to the student's level of participation and the amount of credit to be awarded will be specified in an agreement to be drawn up by the Graduate School and signed by all parties concerned.

Graduate Credit for Senior Undergraduates

A senior in his final semester at the University of Maryland at College Park who is within seven credit hours of completing the requirements for an undergraduate degree may, with the approval of his undergraduate dean, the provost of his division, the department or program offering the course, and the Graduate School, register for graduate courses. These may later be counted for graduate credit toward an advanced degree at the University, if the student has been approved for admission to the Graduate School. The total of undergraduate and graduate courses must not exceed 15 credits for the semester. Excess credits in the senior year cannot be used for graduate credit unless proper prearrangement is made. Seniors who wish to register for graduate credit should inquire at the Graduate School, Office of the Director of Records, for information about the procedure.

Undergraduate Credit for Graduate Level Courses

Subject to requirements determined by the graduate faculty members of the department or program offering the course, undergraduate students may register for graduate level courses, i.e., those numbered from 600 to 898, with the exception of 799 and 899, for undergraduate credit.

A student seeking to utilize this option will normally be in the senior year, have earned an accumulated grade point average of 3.0, have successfully completed, with a grade of B or better, the prerequisite and correlative courses, and be a major in the appropriate or a closely related department. The student will be required to obtain prior approval of the department offering the course.

Enrollment in a graduate level course does not in any way imply subsequent departmental or Graduate School approval for admission into a graduate program, nor may the course be used as credit for a graduate degree at the University of Maryland.

Credit by Examination

A graduate student may obtain graduate credit by examination in courses at the 400 level previously identified by the appropriate department or program. As a general rule, credit by examination is not available for courses at the 600, 700, or 800 levels for, in the judgment of the Graduate Council, courses at these levels require a continuing interaction between faculty and students to achieve the educational goals of advanced study.

A student may receive credit by examination only for a course for which he is otherwise eligible to receive graduate credit. The department or program in which he is enrolled may establish a limit on the number of credits which may be earned in this manner. Graduate students seeking credit by examination must obtain the consent of their advisor and of the instructor currently responsible for the course. Once the student begins the examination, the grade earned will be recorded.

The Graduate School maintains a list of courses for which examinations are available or will be prepared. The fee for credit by examination is $30.00 per course regardless of the number of credits or units to be earned.

Transfer of Credit

A maximum of six semester hours of graduate level course credits earned at regionally accredited institutions prior to, or after, matriculation in the Graduate School may be applied toward master's degrees at the University of Maryland. Proportionately larger amounts of credit may be applied toward doctoral degrees.

All graduate study credits offered as transfer credit must meet the following criteria:

1. They must have received graduate credit at the institution where earned.
2. They must not have been used to meet the requirements for any degree previously earned.
3. They must have been taken within the time limits applicable to degrees awarded by the Graduate School.
4. the department or program to which the student has been admitted at Maryland must certify the courses are appropriate to the degree program the student is pursuing at Maryland.
5. The student must have earned a B or better in the courses offered for transfer credit.
6. Transfer work normally satisfies only the 400 level requirements for the master's degree and does not apply to the upper level requirement.

A student seeking acceptance of transfer credit is advised to submit the necessary transcripts and certification of department or program approval to the Graduate School as promptly as possible for its review and decision.

Criteria that Courses Must Meet to be Accepted for Graduate Credit

Any courses, workshops, or seminars planned to take place in a span of time less than a normal academic semester or summer session and offering graduate credit to the participants must meet the following criteria:

1. There must be 15 "contact hours" per graduate credit.
   a. Lectures: 1 contact hour per 50 minutes lecture.
   b. Non-lecture contact (laboratory, workshops, discussion and problem working sessions, etc.): 1 contact hour per 2 or 3 hour session.
2. No more than three "contact hours" per day will be permitted. (Three "contact hours" are equivalent to 0.2 credits)
3. Credit may be accumulated at the rate of no more than one credit per week.

The Inter-Campus Student

A student admitted to the Graduate School on any campus of the University is eligible to take courses on any other campus of the

University with the approval of his academic advisor and the graduate deans on the home and host campuses. Credits earned on a host campus are resident credit at the home campus and meet all degree requirements. Transcripts of work taken at another campus will be maintained on the home campus, and fees will be paid to the home campus. Forms for registration as an inter-campus student may be obtained from the Graduate School offices on any campus of the University.

Degree Requirements

Graduate School Requirements Applicable to all Master's Degrees.

Programs
The entire course of study undertaken for any master's degree must constitute a unified, coherent program which is approved by the student's advisor and by the Graduate School.

A minimum of thirty semester hours in courses acceptable for credit towards a graduate degree is required; in certain cases six of the thirty semester hours must be thesis research credits. The graduate program must include at least 12 hours of course work at the 600 level or higher. If the student is inadequately prepared for the required graduate courses, additional courses may be required, which may not be considered as part of the student's graduate program. Credits to be applied to a student's program for a master's degree cannot have been used to satisfy any other degree requirements.

Grade-point Average
The student seeking any master's degree must maintain an average grade of B over all courses taken for graduate credit.

Time Limitation
All requirements for the master's degree must be completed within a five year period. This time limit applies to any transfer work from other institutions to be included in a student's program.

Residence Requirements
A minimum residence of one year of full-time study, or its equivalent, at this university is required.

Additional Requirements
In addition to the above requirements, special departmental or collegiate requirements may be imposed, especially for degrees which are offered only in one department, college, or division. For these special requirements consult the descriptions which appear under the departmental or collegiate listing in this catalog or the special publications which can be obtained from the department or college.

Graduate School Requirements for the Degrees of Master of Arts and Master of Science

THESIS OPTION

Course Requirements
A minimum of 30 semester hours including six hours of thesis research credit (799) is required for the degrees of Master of Arts and Master of Science. Of the 24 hours required in graduate courses, no less than 12 must be earned in the major subject. No less than one-half of the total required course credits for the degree, or a minimum of twelve, must be selected from courses numbered 600 or above.

Thesis Requirement
A thesis is required for the Master of Arts and Master of Science degrees except for those programs in which a non-thesis option has been approved by the Dean in conformity with the policy of the Graduate Council. Approval of the thesis is the responsibility of an examining committee appointed by the Dean. The student's advisor is the chairman of the committee, and the remaining members of the committee are members of the graduate faculty who are familiar with the student's program of study. The chairman and the candidate are informed of the membership of the examining committee by the Dean.

Directions for the preparation and submission of theses will be found in the *Graduate Student Academic Handbook*, which may be purchased at the university book store.

Oral Examination
A final oral examination on the thesis shall be held when the student has completed his thesis to the satisfaction of his advisor, providing he has completed all other requirements for the degree and has earned a 3.0 grade average, computed in accordance with the regulations described under "Grades for Graduate Students."

The examining committee, with a minimum of three members, conducts the oral examination (an additional comprehensive written examination may be required at the option of the department or program). The chairman of the examining committee selects the time and place for the examination and notifies other members of the committee and the candidate. Members of the committee must be given a minimum of seven school days in which to read the thesis. The duration of the examination is normally about an hour, but it may be longer if necessary to insure an adequate examination.

The decision to accept the examination as satisfactory must be unanimous. Students may present themselves for examination only twice. The report of the committee, signed by each member, must be submitted to the Dean for Graduate Studies and Research no later than the appropriate date listed in the "Important Dates for Advisors and Students," if the student is to receive a diploma at the Commencement in the semester in which the examination is held.

NON-THESIS OPTION
The requirements for Master of Arts and Master of Science degrees without thesis vary slightly among departments and programs in which this option is available. Standards for admission are, however, identical with those for admission to any other master's program. The quality of the work expected of the student is also identical to that expected in the thesis programs.

The general requirements for those on the non-thesis program are a minimum of 30 semester credit hours in courses approved for graduate credit with a minimum average grade of B in all course work taken; a minimum of 18 semester credit hours in courses numbered 600 or above; the submission of one or more scholarly papers; and successful completion of a comprehensive final examination, a portion of which must be written.

A student following a non-thesis master's program will be expected to meet the same deadlines for application for a diploma and for final examination reports established for all other degree programs.

For information on programs which offer the non-thesis option, see the list of Graduate Programs in this *Catalog*.

Requirements for the Degree of Master of Education

Nearly all departments in Education offer the Master of Education (M.Ed.) degree with the following requirements:

1. A minimum of 30 semester hours in coursework with a grade average of B. Grades for courses not a part of the program but taken in graduate status will be computed in the average.
2. A minimum of 15 hours in courses numbered 600–800 with the remainder at least in the 400 series. Some departments require courses in departments outside of those in Education.
3. A comprehensive written examination taken at the end of coursework. A part of the examination may be oral.
4. EDMS 646 or MUED 690 and one seminar paper; or two seminar papers.
5. EDMS 446 or EDMS 451.
6. Test battery.

For further details, see "Statement of Policies and Procedures: Master's Degrees in Education," issued by the College of Education, and descriptions of departmental programs.

Requirements Applicable to Other Master's Degrees

The particular requirements for the degrees of Master of Architecture, Master of Business Administration, Master of Library Science, Master of Music, and Master of Fine Arts are given under the individual Graduate Program entries in those fields.

Graduate School Requirements Applicable to All Doctoral Degrees

Credit Requirements
The Graduate School requires that every student seeking the doctoral degree register for a minimum of 12 research credits, but the number of research and other credit hours required in the program varies with the degree and program in question.

Residence
The equivalent of three years of full-time graduate study and research is the minimum required. Of the three years, the equivalent of at least one year must be spent at the University of Maryland. On a part-time basis the time needed will be increased correspondingly. All work at other institutions offered in partial fulfillment of the requirements for any doctoral degree must be submitted, with the recommendation of the

department or program concerned, to the Graduate School for approval at the time of application for admission to candidacy. Official transcripts of the work must be filed in the Graduate School.

Admission to Candidacy
Preliminary examinations, or such other substantial tests as the departments may elect, are frequently prerequisite for admission to candidacy.

A student must be admitted to candidacy for the doctorate within five years after admission to the doctoral program and at least one academic year before the date on which the degree will be conferred.

It is the responsibility of the student to submit his application for admission to candidacy when all the requirements for candidacy have been fulfilled. Applications for admission to candidacy are made in duplicate by the student and submitted to the major department for further action and transmission to the Graduate School. Application forms may be obtained at the office of the Assistant to the Dean.

Time Limitation
The student must complete the entire program for the degree, including the dissertation and final examination, during a four year period after admission to candidacy. Extensions of time are granted only under the most unusual circumstances. If a student fails to complete all requirements within the time allotted, he must submit another application for admission to the Graduate School and, if readmitted, another application for Advancement to Candidacy, after satisfying the usual program prerequisites prior to Advancement to Candidacy.

Dissertation
A dissertation or its equivalent is required of all candidates for a doctoral degree. The topic of the dissertation must be approved by the department or program committee.

During the preparation of the dissertation, all candidates for any doctoral degree must register for the prescribed number of semester hours of Doctoral Dissertation Research (899) at the University of Maryland.

Directions for the preparation and submission of dissertations will be found in the *Graduate Student Academic Handbook*, which may be purchased at the university book store.

Publication of the Dissertation
If a student wishes to publish all or a portion of his thesis or dissertation prior to its defense and approval by the Graduate Faculty examining committee, he must first seek the approval of the Dean for Graduate Studies and Research. This approval is sought through a letter to the Dean, endorsed by the dissertation advisor, containing an explanation of the need for early publication.

Final Examination
The final oral defense of the dissertation is conducted by a committee of the Graduate Faculty appointed by the Dean for Graduate Studies and Research. Nominations for membership on the committee are submitted by the student's major professor by the third week of the semester in which the student expects to complete all requirements, but no later than two months prior to the examination, on the designated form.

The major professor serves as chairman of the committee, which will consist of a minimum of five voting members, all of whom hold the doctoral degree. At least one of the five must be a faculty member in a department or Graduate Program at UMCP external to the one in which the student is seeking the degree. A minimum of three members of the committee must be regular members of the Graduate Faculty of the University of Maryland.

One or more members of the committee may be persons from other institutions who hold the doctorate and who are distinguished scholars in the field of the dissertation.

The Dean designates one member of the committee as his representative. In addition to having the normal responsibility of a faculty examiner, the Dean's representative has the responsibility of assuring that the examination is conducted according to established procedures. Any disagreement over the examination procedures is referred to the Dean's representative for decision.

The time and place of the examination are established by the chairman of the committee. The student is responsible for distributing a complete copy of the dissertation to each member of the committee at least ten days before the examination.

All final oral examinations are open to all members of the Graduate Faculty. After the examination, the committee deliberates and votes in private. Two or more negative votes constitute a failure. The student may be examined no more than twice.

Additional Requirements
In addition to the above requirements, special departmental or collegiate requirements may be imposed, especially for those degrees which are offered in only one department, college, or division. For these special requirements, consult the descriptions which appear under the departmental or collegiate listing in this catalog or the special publications which can be obtained from the department, college, or division.

Graduate School Requirements for the Degree of Doctor of Philosophy

The Doctor of Philosophy Degree is granted only upon sufficient evidence of high attainment in scholarship and the ability to engage in independent research. It is not awarded for the completion of course and seminar requirements no matter how successfully completed.

Residence
See requirements for all doctoral degrees.

Foreign Language Requirement
A number of departments have a foreign language requirement for the Doctor of Philosophy degree. The student should inquire in the department regarding this requirement. The student must satisfy the departmental or program requirement before he can be admitted to candidacy for the doctorate.

Program
There is no Graduate School requirement for a specific number of course credits in either a major or a minor subject. It is the policy of the Graduate School to encourage the development of individual programs for each student who seeks the PhD. To that end, the academic departments and interdisciplinary programs have been directed to determine major and minor requirements, levels or sequences of required courses, and similar requirements for submission to the Graduate Council for approval.

Admission to Candidacy
See requirements for all doctoral degrees.

Dissertation
The ability to do independent research must be demonstrated by an original dissertation on a topic approved by the department or program.

During the preparation of the dissertation, all candidates for the Doctor of Philosophy degree must register for a minimum of 12 semester hours of doctoral research (899) at the University of Maryland.

Final Examination
See requirements for all doctoral degrees.

Requirements for the Degree of Doctor of Education

The requirements for the Doctor of Education (Ed.d). degree are for the most part the same as those for the Doctor of Philosophy degree in education departments in the Graduate School. The only difference lies in the amount of credit for the Ed.D. project (6–9 hours) as compared to that required for the Ph.D. disseration (12–16 hours). For details see "Statement of Policy and Procedures: Doctoral Degrees in Education," issued by the College of Education, as well as requirements for the Ph.D., see above, and departmental regulations.

Requirements for Other Doctoral Degrees

The particular requirements for the degrees of Doctor of Business Administration and Doctor of Musical Arts are given under the corresponding program descriptions.

Commencement

Applications for the diploma must be filed with the Office of Admissions and Registrations within the first three weeks of the semester in which the candidate expects to obtain a degree, except during summer session. During the summer session, the application must be filed during the first week of the second summer session. Exact dates are noted for each semester and the summer sessions in "Important Dates for Advisors and Students."

If, for any reason, a student does not graduate at the end of the semester in which he applies for the diploma, he must re-apply for it in the semester in which he expects to graduate.

Academic costume is required of all candidates at commencement exercises. Those who so desire may purchase or rent caps and gowns at the University of Maryland student supply store. Orders must be filed eight weeks before the date of commencement but may be cancelled later if the student finds himself unable to complete the requirements for the degree.

The Graduate Faculty

Abdulhadi, Rami S. Assistant Professor of Mechanical Engineering B.S., University of Illinois at Urbana-Champaign, 1965; M.S., 1969, Ph.D., 1975.

Adams, John O. III Associate Professor of Economics A.B., Oberlin College, 1960; Ph.D., University of Texas, 1965.

Adams, William W. Professor of Mathematics B.A., University of California, Los Angeles, 1959; Ph.D., Columbia University, 1964

Adkins, Arthur J. Associate Professor of Secondary Education B.S., Saint Cloud State College, 1942; M.A., University of Minnesota, 1947, Ph.D., 1958.

Adler, Isidore Professor of Chemistry B.A., Brooklyn College, 1942; B.S., New York University, 1943; M.S., Polytechnic Institute of Brooklyn, 1947; Ph.D., 1952.

Aggour, Mohamed S. Associate Professor, Civil Engineering B.S., Cairo University (Egypt), 1964; M.S., 1966; Ph.D., University of Washington, 1972.

Agrawala, A.K. Associate Professor of Computer Science Ph.D., Harvard University, 1970.

Agre, Gene P. Associate Professor of Social Foundations of Education B.A., Macalester College, 1951, B.S., University of Minnesota, 1953, M.A., Ph.D., University of Illinois, 1964

A'Hearn, Michael F. Associate Professor of Astronomy B.S., Boston College, 1961; Ph.D., University of Wisconsin, 1966.

Ahern, Dennis M. Assistant Professor of Philosophy B.A., Cornell University, 1968; Ph.D., University of California, 1973.

Ahrens, Richard A. Professor of Food and Nutrition and Institutional Administration. B.S., University of Wisconsin, 1958; Ph.D., University of California, Davis, 1963.

Albert, Thomas F. Associate Professor of Veterinary Science B.S., Pennsylvania State University, 1958; VMD, University of Pennsylvania, 1962; Ph.D., Georgetown University, 1972

Alexander, James C. Professor of Mathematics and Statistics B.A., The Johns Hopkins University, 1964; Ph.D., 1968.

Alexander, Millard H. Professor of Chemistry B.A., Harvard College, 1964; Ph.D., Faculte des Sciences, Orsay, 1967.

Allan, J. David Associate Professor of Zoology B.Sc., University of British Columbia, 1966; M.S., University of Michigan, 1968; Ph.D., 1971.

Allan, Thomas Associate Professor of Counseling and Personnel Services B.S., Northwestern University, 1950; M.A., University of Maryland, 1964; Ph.D., 1966.

Alleman, James E. Assistant Professor of Civil Engineering B.S., University of Notre Dame, 1971, M.S., 1973; Ph.D., 1978.

Allen, Redfield W. Professor of Mechanical Engineering B.S., University of Maryland, 1943; M.S., 1949; Ph.D., University of Minnesota, 1959.

Allen, Roger J. Assistant Professor of Health Education, B.S.E., University of Kansas, 1976; M.S., University of Kansas, 1977; Ph.D., University of Maryland, 1979

Alley, Carroll O., Jr. Professor of Physics B.S., University of Richmond, 1948; M.A., Princeton University 1951; Ph.D., 1962.

Almenas, Kazys K. Associate Professor of Nuclear Engineering B.S., University of Nebraska, 1957, Ph.D., University and Polytechnic of Warsaw, 1968

Almon, Clopper, Jr. Professor of Economics A.B., Vanderbilt University, 1956; M.A., Harvard University, 1961, Ph.D., 1962.

Alt, Frank B. Assistant Professor of Business and Management B.E.S., Johns Hopkins University, 1967; M.S., Georgia Institute of Technology, 1974, Ph.D., 1977.

Amershek, Kathleen G. Associate Professor of Early Childhood and Elementary Education B.S., Penn. State Teachers College, 1951; M.Ed., Pennsylvania State University, 1957; Ph.D., University of Minnesota, 1965.

Ames, Carole A. Assistant Professor of Human Development Education B.A., Indiana University, 1967; M.S., 1968, Ph.D., Purdue University, 1976.

Ammon, Herman L. Professor of Chemistry Sc.B., Brown University, 1958, Ph.D., University of Washington, 1962.

Anand, Davinder K. Professor of Mechanical Engineering B.S., George Washington University, 1959, M.S., 1961; D.Sc., 1965.

Anastos, George Professor of Zoology B.S., University of Akron, 1942; M.A., Harvard University, 1947; Ph.D., 1949.

Anderson, Charles R. Associate Professor of Secondary Education and Assistant Dean of the College of Education B.S., University of Maryland, 1957; M.Ed., 1959, Ed.D., 1969.

Anderson, Frank G. Associate Professor of Anthropology A.B., Cornell University, 1941; Ph.D., University of New Mexico, 1951.

Anderson, J. Paul Professor of Administration, Supervision and Curriculum B.S., University of Minnesota, 1942; M.A., 1948, Ph.D., 1960.

Anderson, J. Robert Professor of Physics B.S., State University of Iowa, 1955; Ph.D., 1963.

Anderson, John D., Jr. Professor of Aerospace Engineering B.S., University of Florida, 1959; Ph.D., Ohio State University, 1966.

Anderson, Nancy S. Professor of Psychology B.A., University of Colorado, 1952; M.A., Ohio State University, 1953, Ph.D., 1956.

Anderson, Thornton H. Professor of Government and Politics A.B., University of Kentucky, 1937; M.A., 1938; Ph.D., University of Wisconsin, 1948.

Antman, Stuart S. Professor of Mathematics B.S., Rensselaer Polytechnic Institute, 1961; M.S., University of Minnesota, 1963; Ph.D., 1965.

Armstrong, Earlene Assistant Professor, Entomology B.S., North Carolina Central University, 1969; M.S., 1970; Ph.D., Cornell University, 1975.

Armstrong, Ronald W. Professor of Mechanical Engineering B.E.S., The Johns Hopkins University, 1955; M.Sc., Carnegie-Mellon University, 1957; Ph.D., 1958.

Arnold, Douglas N. Assistant Professor of Mathematics A.B., Brown University, 1975, M.A., University of Chicago, 1976; Ph.D., 1979.

Arrighi, Margarite A. Assistant Professor of Physical Education B.S., Westhampton College, 1958; M.S., University of Maryland, 1962, E.D., University of North Carolina at Greensboro, 1974

Arsenault, Richard J. Professor of Chemical Engineering and Engineering Materials B.S., Michigan Technological University, 1957; Ph.D., Northwestern University, 1962.

Ashby, Genette D. Assistant Professor of French and Italian B.A., Oberlin College, 1969; M.A., Middlebury College, 1971; M. Phil., Columbia University, 1973; Ph.D., 1976

Ashlock, Robert B. Professor of Early Childhood and Elementary Education B.S. Butler University, 1957; M.S., 1959, Ed.D., Indiana University, 1965.

Assad, Arjang A. Assistant Professor of Business and Management B.S., Massachusetts Institute of Technology, 1971; M.S., 1976; Ph.D., 1978.

Atchison, William F. Professor of Computer Science A.B., Georgetown College (Ky.), 1936; M.A., University of Kentucky, 1940; Ph.D., University of Illinois, 1943.

Auslander, Joseph Professor of Mathematics B.S., Massachusetts Institute of Technology, 1952; M.S., University of Pennsylvania, 1953, Ph.D., 1957.

Austing, Richard H. Associate Professor of Computer Science B.S., Xavier University, 1953; M.S., Saint Louis University, 1955; Ph.D., Catholic University of America, 1963.

Avery, William T. Professor and Chairman of Classical Languages and Literatures B.A., Western Reserve University, 1934, M.A., 1935; Ph.D., 1937.

Axelson, Marta L. Assistant Professor, Food, Nutrition and Institution Administration. B.S., Florida State University, 1975; Ph.D., University of Tennessee, 1979

Axley, John H. Professor of Agronomy B.A., University of Wisconsin, 1937; Ph.D., 1945.

Ayars, James E. Assistant Professor, Agricultural Engineering B.A.E., Cornell University, 1965; M.S., Colorado State University, 1973; Ph.D., 1976.

Aycock, Marvin K., Jr. Professor of Agronomy B.S., North Carolina State University, 1959; M.S., 1963; Ph.D., Iowa State University, 1966

Aylward, Thomas J. Professor and Chairman of Communication Arts and Theatre B.S., University of Wisconsin, 1947; M.S., 1949; Ph.D., 1960.

Babuska, Ivo Research Professor, Institute for Physical Science and Technology and Mathematics Dipl. Ing., Technical University of Prague, 1949, Ph.D., 1951, Ph.D., Czechoslovak Academy of Sciences, 1955; Ph.D., 1960.

Baenziger, Peter Stephen Adjunct Assistant Professor of Agronomy B.A., Harvard College, 1972; M.S., Purdue University, 1975; Ph.D., 1975.

Baer, Ferdinand Professor and Director of Meteorology B.A., University of Chicago, 1950; M.S., 1954, Ph.D., 1961.

Bagchi, Amitabha Assistant Professor of Physics B.Sc., Calcutta University, 1964, M.S., University of California, San Diego, 1967; Ph.D., 1970.

Bagnato, Stephen J. Assistant Professor of Counseling and Personnel Services B.S., Clarion State College, 1969; M.S., Pennsylvania State University, 1975, D.Ed., 1977.

Bailey, Martin J. Professor of Economics B.A., University of California, Los Angeles, 1951; M.A., The Johns Hopkins University, 1953; Ph.D., 1956.

Bailey, William J. Research Professor of Chemistry B.Chem., University of Minnesota, 1943; Ph.D., University of Illinois, 1946.

Baker, David W. Lecturer in Mechanical Engineering B.S., University of Maryland, 1943; M.S., 1951; Ph.D., 1967.

Baker, Donald J. Associate Professor of Hearing and Speech Sciences B.S. Ed., Ohio State University, 1954, M.A., 1956; Ph.D., 1962.

Ball, Michael Assistant Professor of Business and Management B.E.S., Johns Hopkins University, 1972; M.S.E., 1972; Ph.D., Cornell University, 1977.

Bandel, Vernon A. Professor of Agronomy B.S., University of Maryland, 1959; M.S., 1962, Ph.D., 1965.

Banerjee, Manoj K. Professor of Physics B.S., Patna University, 1949; M.S., Calcutta University, 1952; Ph.D., 1956.

Baras, John S. Associate Professor of Electrical Engineering Diploma, National Technical University of Athens, 1970; S.M., Harvard University, 1971; PhD., 1973.

Barbosa, Pedro Associate Professor of Entomology B.S., University of Massachusetts, 1966; M.S., 1969, Ph.D., 1971.

Bardasis, Angelo Associate Professor of Physics A.B., Cornell University, 1957; M.S., University of Illinois, 1959; Ph.D., 1962.

Barker, Donald B. Assistant Professor of Mechanical Engineering B.S.M.E., University of Washington, 1969; M.S., 1971; Ph.D., University of California at Los Angeles, 1976.

Barkin, Steve M. Assistant Professor of Journalism A.B., Washington University, 1967; M.S., Columbia University, 1968; Ph.D., Ohio State University, 1979.

Barlow, Jewel B. Associate Professor of Aerospace Engineering B.S., Auburn University, 1963; M.S., 1964; Ph.D., University of Toronto, 1970.

Barnes, Jack C. Associate Professor of English B.A., Duke University, 1939, M.A., 1947; Ph.D., University of Maryland, 1954

Barnett, Audrey J. Associate Professor of Zoology B.A., Wilson College, 1955; M.A., Indiana University, 1957; Ph.D., 1962.

Barnett, Neal M. Associate Professor of Botany B.S., Purdue University, 1959, Ph.D., Duke University, 1966

Barrett, Paul E. Assistant Professor of Botany B.S., University of New Hampshire, 1964; M.S., 1966; Ph.D., University of British Columbia, 1972.

Barry, Jackson G. Associate Professor of English B.A., Yale College, 1950; M.A., Columbia University, 1951; M.F.A., Western Reserve University, 1962; Ph.D., 1963.

Bartlett, Claude J. Professor of Psychology B.S., Denison University, 1954; M.A., Ohio State University, 1956, Ph.D., 1958.

Bartol, Kathryn M. Associate Professor of Business and Management B.A., Marygrove College, 1963; M.A., University of Michigan, 1966; Ph.D., Michigan State University, 1972.

Basham, Ray S. Associate Professor of Electrical Engineering B.S., U.S. Military Academy, 1945, M.S., University of Illinois, 1952; Ph.D., 1962.

Basili, Victor R. Associate Professor of Computer Science B.S., Fordham College, 1961; M.S., Syracuse University, 1963; Ph.D., University of Texas, 1970.

Bean, George A. Professor of Botany B.S., Cornell University, 1958, M.S., University of Minnesota, 1960; Ph.D., 1963.

Beasley, Maurine H. Associate Professor, College of Journalism B.A., University of Missouri, 1958; B.J., 1958; M.S., Columbia University, 1963, Ph.D., George Washington University, 1974.

Beaton, John R. Dean, College of Human Ecology and Professor, Food, Nutrition and Institutional Administration B.A., University of Toronto, 1949, M.A., 1950; Ph.D., 1952

Beatty, Charles J. Associate Professor of Industrial Education B.S., Northern Michigan University, 1959, M.A., Michigan State University, 1963, Ph.D., Ohio State University, 1966.

Bechhoefer, William B. Associate Professor of Architecture A.B., Harvard College, 1963; M. Arch., 1967.

Beck, Kenneth H. Assistant Professor of Health Education, B.S., Pennsylvania State University, 1972; M.A., Syracuse University, 1975; Ph.D., Syracuse University, 1977.

Beckjord, Peter R. Assistant Professor of Forestry (Horticulture) B.S.F., West Virginia University, 1972; M.S.F., 1973; Ph.D., Virginia Polytechnic Institute and State University, 1978.

Beckmann, Robert B. Dean of the College of Engineering and Professor of Chemical Engineering B.S., University of Illinois, 1940; Ph.D., University of Wisconsin, 1944

Bedingfield, James P. Associate Professor of Business and Management B.S., University of Maryland, 1966; M.B.A., 1968, D.B.A., 1971.

Beicken, Peter U. Associate Professor, Germanic and Slavic Languages Mag. Art., University of Munich (Germany), 1968; Ph.D., Stanford University, 1971.

Belcher, Ralph L. Lecturer and Reactor Director, Nuclear Engineering B.S., Marshall University, 1941; M.S., University of Kentucky, 1947; Ph.D., University of Maryland, 1966.

Bell, Roger A. Professor of Astronomy B.S., University of Melbourne, 1957; Ph.D., Australian National University, 1961.

Bellama, Jon M. Professor of Chemistry A.B., Allegheny College, 1960; Ph.D., University of Pennsylvania, 1966.

Belz, Herman J. Professor of History B.A., Princeton University, 1959, M.A., University of Washington, 1963; Ph.D., 1966.

Bender, Filmore E. Professor of Agricultural and Resource Economics B.S., University of California, Berkeley, 1961, M.S., North Carolina State University at Raleigh, 1965; Ph.D., 1966

Benedetto, John J. Professor of Mathematics B.A., Boston College, 1960; M.A., Harvard University, 1962, Ph.D., University of Toronto, 1964.

Benesch, William Adjunct Professor, Institute for Physical Science and Technology B.A., Lehigh University, 1942; M.A., The Johns Hopkins University, 1950; Ph.D., 1952

Bennett, Lawrence H. Adjunct Professor of Physics B.A., Brooklyn College, 1951; M.S., University of Maryland, 1955; Ph.D., Rutgers University, 1958.

Bennett, Robert L. Associate Professor of Economics B.A., University of Texas, 1951; M.A., 1955; Ph.D., 1963.

Bennett, Stanley W. Associate Professor, Institute for Child Study B.S., Iowa State University, 1959; M.A., State University of Iowa, 1961, Ph.D., University of Michigan, 1970.

Bennett, Suzanne Assistant Professor of Hearing and Speech Sciences B.A., Southern Illinois University, 1965, M.A., Western Michigan University, 1969, Ph.D., Purdue University, 1977.

Berenstein, Carlos A. Associate Professor of Mathematics Licendiado en Mathematicas, University of Buenos Aires, 1966; M.S., New York University, 1969, Ph.D., 1970.

Berg, Kenneth R. Associate Professor of Mathematics B.S., University of Minnesota, 1960; Ph.D., 1967

Berger, Bruce S. Professor of Mechanical Engineering B.S., University of Pennsylvania, 1954, M.S., 1958; Ph.D., 1962

Bergeron, Raymond Assistant Professor, Chemistry A.B., Clark University, 1967; Ph.D., Brandeis University, 1973

Bergmann, Barbara R. Professor of Economics B.A., Cornell University, 1948, M.A., Harvard University, 1955, Ph.D., 1959

Berlin, Adele Assistant Professor of Oriental and Hebrew Languages B.H.L., Gratz College, 1963; B.A., University of Pennsylvania, 1964; Ph.D., 1976.

Berman, Joel H. Professor of Music B.S., Juilliard School of Music, 1951; M.A., Columbia University, 1953; D.M.A., University of Michigan, 1961.

Berman, Louise M. Professor of Administration, Supervision and Curriculum and Director of Nursery-Kindergarten School A.B., Wheaton College, 1950; M.A., Columbia University, 1953; Ed.D., Columbia University, 1960.

Bernard, Peter S. Assistant Professor of Mechanical Engineering B.E., City College of CUNY, 1972; M.S., University of California, Berkeley, 1973, Ph.D., 1977.

Bernstein, Allen R. Professor of Mathematics B.A., California Institute of Technology, 1962, M.A., University of California at Los Angeles, 1964, Ph.D., 1965.

Bernstein, Melvin Administrative Dean for Summer Programs and Professor of Music A.B., Southwestern at Memphis, 1947; B.Music, 1948, M. Music, University of Michigan, 1949, M.A., University of North Carolina, 1954, Ph.D., 1964

Best, Otto F. Professor of Germanic and Slavic Languages Abitur, Realgymnasium, 1948; Certificate, University de Toulouse, 1951, Ph.D., University of Munich, 1963

Beste, Charles Edward Associate Professor of Horticulture B.S., Purdue University, 1961, M.S., 1969; Ph.D., 1971

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Wentzel, Donat G. Professor of Astronomy B.A., University of Chicago, 1954; B.S., 1955; M.S., 1956; Ph.D., 1960.

Westbrook, Franklin Associate Professor of Counseling and Personnel Services; and Counselor, Counseling Center B.S., Chicago State University, 1961; M.S., City College of New York, 1964, Ed.D., Indiana University, 1971.

Westerhout, Gart Adjunct Professor of Physics and Astronomy Ph.D., University of Leiden, Netherlands, 1958.

Westhoff, Dennis C. Associate Professor of Dairy Science B.S., University of Georgia, 1966; M.S., North Carolina State University, 1968, Ph.D., 1970.

Wexler, Richard Assistant Professor of Music B.Mus., University of Michigan, 1963; M.A., New York University, 1969; Ph.D., 1974.

Whaples, Gene C. Associate Professor of Agricultural and Extension Education B.S., University of Connecticut, 1960; M.S., Kansas State University, 1965, Ph.D., University of Maryland, 1974.

Wheatley, John Hunter Associate Professor of Agricultural and Extension Education and Secondary Education B.A., Duke University, 1963; M.A.T., 1965; Ph.D., Ohio State University, 1972.

Wheaton, Frederick W. Professor of Agricultural Engineering B.S., Michigan State University, 1964, M.S., 1965; Ph.D., Iowa State University, 1968.

Wheelock, Arthur K., Jr. Assistant Professor Part-time, Art B.A., Williams College, 1965; Ph.D., Harvard University, 1973.

White, Gregory L. Assistant Professor, Psychology B.A., Stanford University, 1971; M.A., University of California (Los Angeles), 1973; Ph.D., 1976.

White, Marvin Hart Professor of Electrical Engineering B.S.E., University of Michigan, 1960; M.S., 1961; Ph.D., Ohio State University, 1969.

Whittemore, E. Reed Professor of English B.A., Yale University, 1941; Litt.D., Carleton College, 1971

Wickes, William C. Assistant Professor of Physics B.S., University of California, 1967; M.A., Princeton University, 1969, Ph.D., 1972.

Widhelm, William B. Associate Professor of Business and Management B.E.S., The Johns Hopkins University, 1959, M.S.E., 1960; M.S., 1965; Ph.D., 1969.

Wiebold, William J. Assistant Professor of Agronomy B.S., Iowa State University, 1971; M.S., 1974; Ph.D., University of Georgia, 1978.

Wiedel, Joseph W. Associate Professor of Geography B.A., University of Maryland, 1958; M.A., 1963.

Wiley, Robert C. Professor of Horticulture B.S., University of Maryland, 1949; M.S., 1950; Ph.D., Oregon State University, 1953.

Wilkenfeld, Jonathan Associate Professor of Government and Politics B.S., University of Maryland, 1964; M.A., George Washington University, 1966; Ph.D., Indiana University, 1969.

Wilkerson, Thomas D. Research Professor, Institute for Fluid Dynamics and Applied Mathematics B.S., University of Michigan, 1953; M.S., 1954; Ph.D., 1962.

Williams, Aubrey W. Professor of Anthropology B.A., University of North Caroline, 1955; M.A., 1957; Ph.D., University of Arizona, 1964

Williams, David L. Associate Professor of Early Childhood and Elementary Education B.S., Bradley University, 1952; M.Ed., University of Illinois at Urbana, 1956; Ed.D., 1964

Williams, Eleanor Associate Professor, Food, Nutrition and Institutional Administration B.S., Texas Woman's University, 1945; M.S., Iowa State University, 1947, Ph.D., Cornell University, 1963.

Williams, Walter F. Professor of Dairy Science B.S., University of Missouri, 1951; M.S., 1952; Ph.D., 1955.

Williams, William H. Assistant Professor of History B.A., Washington & Lee University, 1956; M.A., Duke University, 1960; Ph.D., 1965

Willis, William Assistant Professor of Art B.A., University of South Florida, 1968, M.F.A., 1973.

Wilson, Andrew S. Assistant Professor of Astronomy B.A., University of Cambridge, England, 1969; M.A., 1973; Ph.D., 1973.

Wilson, Bruce D. Assistant Professor of Music B.Mus., University of Michigan, 1960; M.Mus., 1964, Ph.D., 1973.

Wilson, Gayle L. Associate Professor of English B.A., Wayne State University, 1960; M.A., University of Rochester, 1963; Ph.D., 1965.

Wilson, Leda A. Associate Professor of Family and Community Development B.S., Lander College, 1943; M.S., University of Tennessee, 1950; Ed.D., 1954

Wilson, Mark Edward Assistant Professor of Music B.A., University of California at Los Angeles, 1970, M.A., 1972; Ph.D., 1974

Wilson, Robert M. Professor of Early Childhood and Elementary Education B.S., California State College (Pennsylvania), 1950; M.S., University of Pittsburgh, 1956; Ed.D., 1960.

Winkelnkemper, Horst E. Associate Professor of Mathematics B.A., National University of Mexico, 1963; M.A., Princeton University, 1965; Ph.D., 1970.

Winton, Calhoun Professor, English A.B., University of the South (Sewane), 1948; M.A., Vanderbilt University, 1950; M.A., Princeton University, 1954; Ph.D., 1955.

Wirth, Willis W. Adjunct Professor of Entomology B.S., Iowa State University, 1940; M.S., Louisiana State University, 1947; Ph.D., University of California, Berkeley, 1950.

Wiss, Gene Professor of American Studies B.A., Hanover College, 1958; Ph.D., Syracuse University, 1963.

Witczak, Matthew W. Professor of Civil Engineering B.S.C.E., Purdue University, 1962; M.S.C.E., 1963; Ph.D., 1969

Withers, Josephine Associate Professor of Art B.A., Oberlin College, 1960; M.A., Columbia University, 1965; Ph.D., 1971

Wittreich, Joseph A. Professor of English Language and Literature A.B., University of Louisville, 1961, M.A., 1962; Ph.D., Western Reserve University, 1966.

Wolfe, Peter Professor of Mathematics and Statistics B.S., St. Lawrence University, 1959; M.S., Northwestern University, 1961; Ph.D., New York University, 1965.

Wolken, John D. Assistant Professor, Institute for Urban Studies B.A., University of Southern California, 1968; M.A., 1973; Ph.D., 1975.

Wolpert, Scott A. Assistant Professor of Mathematics B.S., Johns Hopkins University, 1972; M.S., Stanford University, 1974, Ph.D., 1976.

Wolvin, Andrew D. Professor of Communication Arts and Theatre B.S., University of Nebraska, 1962; M.A., 1963, Ph.D., Purdue University, 1968

Wonnacott, Paul Professor of Economics B.A., University of Western Ontario, 1955, M.A., Princeton University, 1957; Ph.D., 1959.

Woo, Ching-Hung Professor of Physics and Astronomy B.S., Louisiana Technological Institute, 1958; M.S., University of California, Berkeley, 1959; Ph.D., 1962

Wood, Francis E. Associate Professor, Entomology B.S., University of Missouri, 1958; M.S., 1962; Ph.D., University of Maryland, 1970.

Woolpert, Stephen B. Associate Professor, Government and Politics B.A., Grinnell College, 1966; M.A., The Johns Hopkins University, 1968; Ph.D., Stanford University, 1977

Wrenn, Jerry P. Assistant Professor of Physical Education B.S., East Carolina College, 1961, M.S., University of Tennesee, 1963; Ph.D., University of Maryland, 1970.

Wright, Kieth C. Associate Professor, College of Library and Information Services B.A., Willamette University, 1955, M.L.S., Columbia University, 1968, Ph.D., 1972.

Wright, Winthrop R. Associate Professor of History B.A., Swarthmore College, 1958; M.A., University of Pennsylvania, 1960; Ph.D., 1964

Wu, Ching-Sheng Research Professor, Institute for Fluid Dynamics and Applied Mathematics B.S., National Taiwan University, 1954, M.S., Virginia Polytechnic Institute, 1956, Ph.D., Princeton University, 1959

Wylie, Ann G. Associate Professor of Geology B.A., Wellesley College, 1966, Ph.D., Columbia University, 1972.

Wysong, John W. Professor of Agricultural and Resource Economics B.S., Cornell University, 1953, M.S., University of Illinois, 1954, Ph.D., Cornell University. 1957.

Yaney, George L. Professor of History B.Mgt.E., Rensselaer Polytechnic Institute, 1952; M.A., University of Colorado, 1956, Ph.D., Princeton University, 1961.

Yang, Grace L. Associate Professor of Mathematics and Statistics B.A., National Taiwan University, 1960, M.A., University of California, Berkeley, 1963, Ph.D., 1966

Yang, Jackson C. Professor of Mechanical Engineering B.S., University of Maryland, 1958; M.A., 1961, Ph.D., 1963

Yang, Paul C. Assistant Professor of Mathematics A.B., University of California, Berkeley, 1969, Ph.D., 1973

Yerian, Richard A. Assistant Professor of Health Education B.S., Ball State University, 1971; M.S., 1972; Ed.S., 1973; Ph.D., University of Maryland, 1976.

Yaramanoglu, Melih Assistant Professor of Agricultural Engineering B.S., Middle East Technical University, 1971; M.S., 1973, Ph.D., University of Maryland, 1978.

Yeh, Kwan-Nan Associate Professor of Textiles and Consumer Economics B.S., National Taiwan University, 1961; M.S., Tulane University, 1965; Ph.D., University of Georgia, 1970.

Yeni-Komshian, Grace Associate Professor of Linguistics B.A., American University of Beirut, 1957; M.S., Cornell University, 1962; Ph.D., McGill University, 1965.

Yff, Joost Acting Chairman of Early Childhood/Elementary Education B.S.E., State College at Fitchburg, 1959; M.A., University of Maryland, 1961; Ph.D., 1965.

Yodh, Gaurang B. Professor of Physics and Astronomy B.Sc., University of Bombay, 1948; M.Sc., University of Chicago, 1951; Ph.D., 1955.

Yorke, James Alan Research Professor, Institute for Physical Science and Technology and Mathematics A.B., Columbia University, 1963; Ph.D., University of Maryland, 1966.

Young, Bobby G. Professor of Microbiology B.A., Southeast Missouri State College, 1950; Ph.D., The Johns Hopkins University, 1965.

Young, Edgar P. Professor of Animal Science B.S., Ohio State University, 1954, M.S., 1956; Ph.D., 1958.

Young, Oran R. Professor, Government and Politics A.B., Harvard University, 1962; M.A., Yale University, 1964; Ph.D., 1965.

Zagier, Don Bernard Professor of Mathematics B.S., Massachusetts Institute of Technology, 1968; Dipl. Adv., Oxford University, 1969, Ph.D., 1972, Habilitation, Universitat Bonn, 1975.

Zajac, Felix E. III Associate Professor of Electrical Engineering B.E.E., Rensselaer Polytechnic Institute, 1962; M.S., Stanford University, 1965, Ph.D., 1968

Zaki, Kawthar A. Associate Professor of Electrical Engineering B.S., Ain-Syams University, 1962, M.S., University of California, Berkeley, 1966, Ph.D., 1969.

Zalcman, Lawrence Allen Professor of Mathematics A.B., Dartmouth College, 1964, Ph.D., Massachusetts Institute of Technology, 1968

Zanot, Eric J. Assistant Professor of Journalism B.A., Pennsylvania State University, 1965, M.A., 1970, Ph.D., University of Illinois, 1977.

Zave, Pamela Assistant Professor of Computer Science B.A., Cornell University, 1970; M.S., University of Wisconsin, 1972; Ph.D., 1976.

Zedek, Michael Professor of Mathematics and Statistics M.S., Hebrew University of Jerusalem, 1952; Ph.D., Harvard University, 1956.

Zelkowitz, Marvin Associate Professor of Computer Science B.S., Renssalaer Polytechnic Institute, 1967; M.S., Cornell University, 1969, Ph.D., 1971.

Zilfi, Madeline C. Assistant Professor of History A.B., Mount Holyoke College, 1964, M.A., University of Chicago, 1970; Ph.D., 1976.

Zipoy, David M. Associate Professor of Astronomy B.S., University of Minnesota, 1954; Ph.D., 1957.

Zoller, William H. Professor of Chemistry B.S., University of Alaska, 1965; Ph.D., Massachusetts Institute of Technology, 1969

Zorn, Bice Sechi Professor of Physics Dottore in Fiscia, University of Cagliari, 1952.

Zorn, Gus T. Professor of Physics B.S., Oklahoma State University, 1948; M.S., University of New Mexico, 1953; Ph.D., University of Padua, 1954

Zuckerman, Benjamin M. Professor of Astronomy B.S., Massachusetts Institute of Technology, 1963, M.S., 1963; Ph.D., Harvard University, 1968

Zwanzig, Robert W., Research Professor, Institute for Physical Science and Technology B.S., Brooklyn Polytechnic Institute, 1948, M.S., University of Southern California, 1950; Ph.D., California Institute of Technology, 1952

Graduate Programs

Administration, Supervision, and Curriculum Program

Professor and Chairman: Warren
Professors: Anderson, J.P., Anderson, V.E. (Emeritus), Berdahl, Berman, Carbone, Dudley, McClure, McLoone, Newell, Stephens, van Zwoll (Emeritus), Wiggin (Emerita)
Associate Professors: Clague, Goldman, Selden, Splaine
Assistant Professors: Brand, Clabaugh, Intriligator, King (Visiting)

The Department of Administration, Supervision, and Curriculum offers programs of study for the M.A., M.Ed., Ed.D., and Ph.D. degrees as well as for the Advanced Graduate Specialist certificate. Areas of specialization include: administration, supervision, curriculum, adult and higher education, and educational technology. Programs in all areas are individually designed for careers in public or private elementary and secondary schools, adult and higher education, other education agencies, government agencies, and non-school educational settings.

Admission and Degree Information

Admission at the doctoral level is based upon a number of criteria, including grade-point average and standardized test scores. Selective screening of qualified applicants at the master's, A.G.S., and doctoral levels is necessary in terms of limiting enrollment to the available faculty resources of the Department.

A field internship or its equivalency is required of all A.G.S. and Ed.D. candidates. This internship is performed under faculty supervision in schools, colleges or agencies, in roles that are consistent with the candidate's program emphasis.

Facilities and Special Resources

The Department has developed close working relationships with area schools, community colleges and education agencies so that they may serve as resources for the academic offerings on campus. Procedures have been established which facilitate the use of these agencies for research and field experiences. The Educational Technology Center in the College of Education is used extensively by students in the Department, particularly those in curriculum.

Financial Assistance

Some Graduate Assistantships are available to qualified graduate students.

Additional Information

For information and a departmental brochure, please write to the Director of the Graduate Program.

Courses

EDAD 440 Utilization of Educational Media (3) Survey of Classroom uses of Instructional media. Techniques for integrating media into instruction. Includes preparation of a unit of instruction utilizing professional and teacher produced media.

EDAD 441 Graphic Materials for Instruction (3) Prerequisites: EDAD 440 or consent of instructor. A laboratory course which combines graphic and photographic processes for education and training purposes. Techniques include lettering, coloring, transparencies, illustrations, converting, duplicating transparent and opaque media. Emphasis is placed on appropriate media selection for target audiences. Heavy student project orientation.

EDAD 442 Instructional Media Services (3) Prerequisites: Teaching experience and EDAD 440, or equivalent. Procedures for coordinating instructional media programs; instructional materials acquisition, storage, scheduling, distribution, production, evalution and other service responsibilities; instructional materials center staff coordination of research, curriculum improvement and faculty development programs.

EDAD 443 Instructional Television Utilization (3) Combining televised lessons, on-campus seminars, and related workbook assignments, this course focuses upon planning for the various uses of instructional television with students. State, local school unit, school, and classroom uses will be illustrated through film and studio production. The aspects of producing ITV programs are developed through the television lessons and 'Hands-on' assignments of the seminars.

EDAD 444 Programmed Instruction (3) Analysis of programmed instruction techniques; selection, utilization and evaluation of existing programs and teaching machines; developing learning objectives; writing and validating programs.

EDAD 489 Field Experience in Education (1–4) Prerequisites: At least six semester hours in education at the University of Maryland plus such other prerequisites as may be set by the major area in which the experience is to be taken. Planned field experience may be provided for selected students who have had teaching experience and whose application for such field experience has been approved by the education faculty. Field experience is offered in a given area to both major and nonmajor students. NOTE—The total number of credits which a student may earn in EDAD 489, 888, and 889 is limited to a maximum of 20 semester hours.

EDAD 494 The Legal Rights and Obligations of Teachers (3) and Students Selected state and federal court decisions, legislation, and executive guidelines regulating public education. Speech and other forms of expression, privacy, suspensions, expulsions, search and seizure, tort liability for negligence (including educational malpractice), hiring, promotion, dismissal and non-renewal of teachers. No prior legal training required.

EDAD 498 Special Problems in Education (1–3) Prerequisite: Consent of instructor. Available only to mature students who have definite plans for individual study of approved problems.

EDAD 499 Workshops, Clinics, Institutes (1–6) The maximum number of credits that may be earned under this course symbol toward any degree is six semester hours; the symbol may be used two or more times until six semester hours have been reached. The following type of educational enterprise may be scheduled under this course heading: workshops conducted by the College of Education (or developed cooperatively with other colleges and universities) and not otherwise covered in the present course listing; clinical experiences in pupil-testing centers, reading clinics, speech therapy laboratories, and special education centers. Institutes developed around specific topics or problems and intended for designated groups.

EDAD 602 The Junior College (3)

EDAD 603 Problems in Higher Education (3)

EDAD 605 Administrative Foundations (3) EDAD 605 is presented as the first of the four courses for students majoring in the field of Educational Administration, Supervision, and Curriculum Development. It attempts to structure a theoretical and research base for the study and practice of administration in the field of education by introducing the student to selected contributors to administration, and by indicating the multidisciplinary nature of administrative study as it relates to purpose-determination, policy-definition, and task-accomplishment.

EDAD 606 Administrative Behavior and Organizational Management (3) A critical analysis of organizational management (informal and formal dimensions), an assessment of the contributions from other fields (traditional and emerging) to the study of administrative behavior and the governance of organizations, and an analysis and assessment of the administrator's motivations, perceptions, and sensitivity as determinants of behavior constitute the major units of study for EDAD 606. The theoretical and research bases for these areas and such related concepts as status, role, systems, interpersonal relations, and sensitivity training are examined.

EDAD 607 Administrative Processes (3) EDAD 607 is designed to develop competence with respect to selected administrative process areas. It examines efforts to develop theories and models in these areas and analyzes research studies and their implications for administrative practice. In addition it seeks to develop skill in selected process areas through such techniques as simulation, role-playing, case analysis, and computer-assisted instruction.

EDAD 608 Administrative Relationships (3) EDAD 608 is structured to provide the student of educational administration with an understanding of the various groups and subgroups to which an administrator relates and to the significance of these relationships for leadership behavior. It provides an opportunity to examine and analyze significant principles, concepts, and issues in the areas of personnel administration, public relations, community, state, and federal agencies. The human relations skills essential to effective leadership in these areas constitute the other dimension of this course.

EDAD 611 The Organization and Administration of Secondary Schools (3) Prerequisite: Consent of instructor. The work of the secondary school school-community relationships, student activities, schedule making, and internal financial accounting.

EDAD 612 School Finance and Business Administration (3) An introduction to principles and practices in the administration of the public school finance activity. Sources of tax revenue, the budget, and the function of finance in the educational program are considered.

EDAD 616 Public School Supervision (3) The nature and functions of supervision; various supervisory techniques and procedures; human relationship factors; and personal qualities for supervision.

EDAD 617 Administration and Supervision in Elementary Schools (3) Problems in administering elementary schools and improving instruction.

EDAD 620 General Systems Theory I (3) Prerequisite: EDAD 607 or permission of instructor. Theory of complex systems, principles and mechanisms of regulation, control, and adaptation in physical, biological, social, and symbolic systems Equi-Finality, evolution, feedback, hierarchy theory, homeostasis, requisite variety, and self-organization. Applications to policy making, planning, and management in educational organizations.

EDAD 621 General Systems Theory II (3) Prerequisite: EDAD 620 or permission of instructor. General systems theory applied to actual organizational problems. Field work and relevant social science literature for the definition of one or more key, long-range problems and the development of plans to solve the problems.

EDAD 630 Elementary and Secondary School Law (3) Selected court opinions, legislation and executive guidelines regulating elementary and secondary education. Equal educational opportunity, first and fourth amendment rights of students and teachers, tort liability for negligence, equal protection in hiring, firing and non-renewal of teachers, individual and institutional liability for federal civil rights violations and common law torts. No prior legal training required.

EDAD 631 Higher Education Law (3) Selected court opinions, legislation and executive guidelines regulating higher education. First and fourth amendment rights of students and faculty, procedural due process, equal educational opportunity, equal protection in hiring, promotion, non-renewal and salaries, individual and institutional liability for civil rights violations and common law torts. No prior legal training required.

EDAD 632 Collective Bargaining in Elementary-Secondary Education (3) Evolution and impact of collective bargaining in elementary and secondary education. Impact of collective bargaining on the educational power structure, third-party community interests and educational policy making.

EDAD 633 Collective Bargaining in Higher Education (3) Legal and educational policy of collective bargaining in higher education. Nature and scope of the bargaining process, impact of collective bargaining on academic governance, student interests, personnel decisions, and grievance mechanisms.

EDAD 634 The School Curriculum (2–3) A foundations course embracing the curriculum as a whole from early childhood through adolescence, including a review of historical developments, an analysis of conditions affecting curriculum change, an examination of issues in curriculum making, and a consideration of current trends in curriculum design.

EDAD 635 Principles of Curriculum Development (3) Curriculum planning, improvement, and evaluation in the schools; principles for the selection and organization of the content and learning experiences; ways of working in classroom and school on curriculum improvement.

EDAD 636 Communication and the School Curriculum (3) Curriculum development based on communication as the major vehicle for describing the learner's interactions with persons, knowledge, and materials in the classroom and school environment. (Also listed as EDEL 636)

EDAD 641 Selection and Evaluation of Instructional Media (3) Development of criteria for selection and evaluation of instructional materials for classroom, school and system use; includes measures of readability, listenability, visual difficulty, and interest level.

EDAD 642 Mediated Instructional Systems (3) Prerequisite: EDAD 440 and EDAD 444. Survey of innovative instructional systems. Comparison of effectiveness of alternate teaching-learning systems. System design to improve teaching-learning efficiency through instructional media.

EDAD 644 Practicum in Instructional Systems (2–6) Prerequisite: EDAD 444 or EDAD 642. Design and development of experimental instructional materials or systems to solve a specific instructional problem in the field.

EDAD 679 Seminar in Educational Administration and Supervision (2–4) Prerequisite: At least four hours in educational administration and supervision or consent of instructor. A student may register for two hours and may take the seminar a second time for an additional two hours.

EDAD 718 School Surveys (2–6) Prerequisite: Consent of instructor. Includes study of school surveys with emphasis on problems of school organization and administration, finance and school plant planning. Field work in school surveys is required

EDAD 723 The Human Dimension in Administration (3) Prerequisite: EDAD 605 or consent of instructor. Theory, research findings, and laboratory experiences in human skills in organizations. Goal setting, communication, conflict, decision making evaluation, and consultant intervention.

EDAD 724 Group Relationships in Administration (3) Prerequisite: EDAD 605 or consent of instructor. Group relationships and relevant administrative skills in educational settings. The role of authority, group maturation, group member roles, group decision making, and intra- and inter-group conflict.

EDAD 726 Child Accounting (2) An inquiry into the record keeping activities of the school system, including an examination of the marking system.

EDAD 727 Public School Personnel Administration (3) A comparison of practices with principles governing the satisfaction of school personnel needs, including a study of tenure, salary schedules, supervision, rewards, and other benefits.

EDAD 738 Scholarly Thought and Contemporary Curriculum (1–3) Current curricular trends, issues, theory, and research in the light of past curricular and social thought. Linguistic analysis, analysis of thinking, disciplines as modes of inquiry, influence of romantic thought, influence of the industrial model, school as transformer of society, and political ideologies. May be repeated to a maximum of six credits.

EDAD 750 Organization and Administration of Teacher Education (3) Teacher education today. Current patterns and significant emerging changes, particularly those involving teachers and schools. Deals with selection, curriculum, research, accredition, and institution-school relationships.

EDAD 798 Special Problems in Education (1–6) Master's, AGS, or doctoral candidates who desire to pursue special research problems under the direction of their advisors may register for credit under this number.

EDAD 799 Master's Thesis Research (1–6) Registration required to the extent of six hours for master's thesis.

EDAD 802 Curriculum in Higher Education (3) An analysis of research in curriculum and of conditions affecting curriculum change, with examination of issues in curriculum making based upon the history of higher education curriculum development.

EDAD 803 Organization and Administration of Higher Education (3) Organization and administration of higher education at the local, state, and federal levels; and an analysis of administrative relationships and functions and their effects in curriculum and instruction.

EDAD 805 College Teaching (3) Various methods of college instruction analyzed in relation to the curriculum and psychological basis. These would include the case study method, the demonstration method, the lecture method, the recitation method, teaching machines, teaching by television, and other teaching aids.

EDAD 806 Seminar in Problems of Higher Education (3) Contemporary issues and problems in post-secondary education relevant to the interests of both administrators and college/university faculty members. Problems of individual interest. Preparation of publishable papers on post-secondary education topics.

EDAD 837 Curriculum Theory and Research (2)

EDAD 857 Administration of Adult and Continuing Education (3) An overview of the field of Adult Continuing Education focusing on the administration of institutions and organizations that provide both credit and non-credit educational experiences for adult learners. Historical Development of Adult Education in America. Concepts that have molded the adult education movement, and issues in financing and delivering adult education programs.

EDAD 859 Seminar in Adult Education (3)

EDAD 861 Seminar: Research in School Effectiveness (3) Prerequisite: EDAD 605, 606, 607, 608, and consent of instructor. Examination of organizational effectiveness and the methodologies for assessing organizational effectiveness. An individual research project is required.

EDAD 862 Seminar: Theoretical Basis of Administrative Behavior (3) Prerequisite: EDAD 605, 606, 607, 608, and consent of instructor. Study of administrative behavior in educational institutions. Development of a research design for the study of administrative behavior in one educational institution.

EDAD 865 Doctoral Research Seminar (3) Prerequisite: Consent of instructor. Development of the dissertation proposal. Definition of the problem, development of research design, design of data collection processes, and discussion of writing of the dissertation.

EDAD 879 Seminar in Teacher Education (3–6) A problem seminar in teacher education. A maximum of six hours may be earned in this course.

EDAD 888 Apprenticeship in Education (1–8) Apprenticeships in the major area of study are available to selected students whose application for an apprenticeship has been approved by the Education faculty. Each apprentice is assigned to work for at least a semester full-time or the equivalent with an appropriate staff member of a cooperating school, school system, or educational institution or agency. The sponsor of the apprentice maintains a close working relationship with the apprentice and the other persons involved. Prerequisites: Teaching experience, a master's degree in Education, and at least six semester hours in Education at the University of Maryland. NOTE: The total number of credits which a student may earn in EDAD 489, 888, and 889 is limited to a maximum of twenty (20) semester hours.

EDAD 889 Internship in Education (3–8) Internships in the major area of study are available to selected students who have teaching experience. The following groups of students are eligible: (A) any student who has been advanced to candidacy for the doctor's degree; and (B) any student who receives special approval by the Education faculty for an internship, provided that prior to taking an internship, such student shall have completed at least 60 semester hours of graduate work, including at least six semester hours in Education at the University of Maryland. Each intern is assigned to work on a full-time basis for at least a semester with an appropriate staff member in a cooperating school, school system, or educational institution or agency. The internship must be taken in a school situation different from the one where the student is regularly employed. The intern's sponsor maintains a close working relationship with the intern and the other persons involved. NOTE: The total number of credits which a student may earn in EDAD 489, 888, and 889 is limited to a maximum of twenty (20) semester hours.

EDAD 899 Doctoral Dissertation Research (1–8) Registration required to the extent of 6–9 hours for an Ed.D. Project and 12–18 hours for a Ph.D. dissertation.

Aerospace Engineering Program

Professor and Chairman: Gessow
Professors: Anderson, Corning, Donaldson, Melnik, Pai, Plotkin
Associate Professors: Barlow, Jones
Assistant Professors: Lee, Winklemann
Lecturers: Billig, Case, Chander, Fleig, Griffen, Krone, Waltrup

The Aerospace Engineering Department offers a broad program of graduate studies leading to the degrees of Master of Science and Doctor of Philosophy. The curricula for these degrees are adapted to meet the objectives and background of the individual student and are planned by the student and his advisor. Applications for admission are invited from those holding a B.S. degree in engineering, the physical sciences, and mathematics. Aerodynamics and Propulsion,

Structural Mechanics, and Flight Dynamics are the major areas of specialization available to graduate students. Within these areas of specialization, the student can tailor programs such as Computational Mechanics, and High Temperature Gas Dynamics.

Admission and Degree Information

Two master's degree options are available; thesis and non-thesis. No special departmental requirements are imposed beyond the Graduate School requirements.

For the Doctor of Philosophy degree, the Aerospace Engineering Department requires a minimum of 48 semester hours of course-work beyond the B.S. including (1) not less than 18 hours within one departmental area of specialization, (2) not less than 9 hours from among the other areas of specialization in the department, (3) not less than 12 hours in courses which emphasize the physical sciences or mathematics rather than their applications. The total in (2) plus that in (3) must be at least 24 hours of which no more than 6 are less than 600 level. Written and oral comprehensive examinations are also required.

Facilities and Special Resources

The research facilities of the department are available to the graduate student. The aerodynamic facilities include two subsonic, two supersonic, a hypersonic wind tunnel, a GAT–1 flight simulator, and a F–101 flight simulator. Facilities are also available for static and vibration testing of structures. An assortment of computers including a UNIVAC 1140 and a UNIVAC 1108 complemented by remote access units on a time-sharing basis are available. The Department provides special facilities for the use of students which include remote terminals and mini-computers. Under special circumstances, thesis research may be accomplished in off-campus research facilities.

Financial Assistance

A number of graduate assistantships and fellowships are available for financial assistance.

Courses

ENAE 401 Aerospace Laboratory II (2) Prerequisites: ENAE 305 and ENAE 345. Corequisites: ENAE 452 and ENAE 471. Application of fundamental measurement techniques to experiments in Aerospace Engineering, structural, aerodynamic, and propulsion tests, correlation of theory with experimental results.

ENAE 402 Aerospace Laboratory III (1) Prerequisites: ENAE 305 and ENAE 345. Corequisites: ENAE 452, ENAE 471, and ENAE 475. Application of fundamental measurement techniques to experiments in aerospace engineering, structural, aerodynamic, flight simulation, and heat transfer tests. Correlation of theory with experimental results.

ENAE 411 Aircraft Design (3) Prerequisites: ENAE 345, ENAE 451, and ENAE 371. Theory, background and methods of airplane design, subsonic and supersonic.

ENAE 412 Design of Aerospace Vehicles (3) Prerequisites: ENAE 345 and ENAE 371. Theory, background and methods of space vehicle design for manned orbiting vehicles, manned lunar and planetary landing systems.

ENAE 415 Computer-Aided Structural Design Analysis (3) Prerequisite: ENAE 452 or consent of instructor. Introduction to structural design concepts and analysis techniques. Introduction to computer software for structural analysis which is utilized to verify exact solutions and perform parametric design studies of aerospace structures. Not open to students who have earned credit in ENAE 431.

ENAE 445 Stability and Control of Aerospace Vehicles (3) Prerequisite: ENAE 345 and ENAE 371. Stability, control and miscellaneous topics in dynamics.

ENAE 451 Flight Structures I—Introduction to Solid Mechanics (4) Prerequisite: ENES 220. An introduction to the analysis of aircraft structural members. Introduction to theory of of elasticity, mechanical behavior of materials, thermal effects, finite-difference approximations, virtual work, variational and energy principles for static systems.

ENAE 452 Flight Structures II: Structural Elements (3) Prerequisite: ENAE 451. Application of variational and energy principles to analysis of elastic bodies; stresses and deflections of beams including effects of non—principal axes, non—homogeneity, and thermal gradients; differential equations of beams, bars, and cables. Stresses and deflections of torsional members, stresses due to shear. Deflection analysis of structures.

ENAE 453 Matrix Methods in Computational Mechanics (3) Prerequisite: ENAE 452 or consent of instructor. Introduction to the concepts of computational analysis of continuous media by use of matrix methods. Foundation for use of finite elements in any field of continuum mechanics, with emphasis on the use of the displacement method to solve thermal and structural problems.

ENAE 457 Flight Structures III (3) Prerequisite: ENAE 452 or equivalent. An advanced undergraduate course dealing with the theory and analysis of the structures of flight vehicles. Stresses due to shear, indeterminate structures, plate theory, buckling and failure of columns and plates.

ENAE 461 Flight Propulsion I (3) Prerequisites: ENME 216 and ENAE 471. Operating principles of piston, turbojet, tuboprop, ramjet and rocket engines, thermodynamic cycle analysis and engine performance, aerothermochemistry of combustion, fuels, and propellants.

ENAE 462 Flight Propulsion II (3) Prerequisite: ENAE 461. Advanced and current topics in flight propulsion.

ENAE 471 Aerodynamics II (3) Prerequisite: ENAE 371 and ENME 216. Elements of compressible flow with applications to aerospace engineering problems.

ENAE 472 Aerodynamics III (3) Prerequisite: ENAE 371. Theory of the flow of an incompressible fluid.

ENAE 473 Aerodynamics of High-Speed Flight (3) Prerequisite: ENAE 472 or equivalent. An advanced course dealing with aerodynamic problems of flight at supersonic and hypersonic velocities. Unified hypersonic and supersonic small disturbance theories, real gas effects, aerodynamic heating and mass transfer with applications to hypersonic flight and re-entry.

ENAE 475 Viscous Flow and Aerodynamic Heating (3) Prerequisites: ENAE 371, ENAE 471, and ENME 216. Fundamental aspects of viscous flow. Navier-Stokes equations, similarity, boundary layer equations; laminar, transitional and turbulent incompressible flows on airfoils, thermal boundary layers and convective heat transfer; conduction through solids, introduction to radiative heat transfer.

ENAE 488 Topics in Aerospace Engineering (1–4) Technical elective taken with the permission of the student's advisor and instructor. Lecture and conference courses designed to extend the student's understanding of aerospace engineering. Current topics are emphasized.

ENAE 499 Elective Research (1–3) May be repeated to a maximum of three credits. Elective for seniors in Aerospace Engineering with permission of the student's advisor and the instructor. Original research projects terminating in a a written report.

ENAE 640 Flight Mechanics I (3) Prerequisites: ENAE 445 or consent of instructor. Studies in the dynamics and control of flight vehicles. Fundamentals of the dynamics of rigid and non-rigid bodies and their motion under the influence of aerodynamic and gravitational forces.

ENAE 641 Flight Mechanics II (3) Prerequisites: ENAE 640 or consent of instructor. A continuation

ENAE 646 Helicopter Theory I (3) Prerequisites: ENAE 461 or consent of instructor. Theories of rotor aerodynamics in axial and nonaxial flight, dynamics of rotor blades, helicopter performance, stability, control, and current methods of helicopter dynamic analysis. Development of a digital program for dynamic simulation of helicopter flight.

ENAE 647 Helicopter Theory II (3) Prerequisites: ENAE 646 or consent of instructor. A continuation of ENAE 646.

ENAE 650 Variational Methods in Structural Mechanics (3) Prerequisites: ENAE 452 or equivalent. Review of theory of linear elasticity with introduction to cartesian tensors; application of calculus of variations and variational principles of elasticity; Castigliano's theorems; applications to aerospace structures.

ENAE 652 Finite Element Method in Engineering (3) Prerequisite: ENAE 453 and ENAE 650, or consent of instructor. Development of finite element representation of continua using galerkin and variational techniques. Derivation of shell elements and parametric representation of two and three dimensional elements. Application to aerospace structures, fluids and diffusion processes.

ENAE 653 Nonlinear Finite Element Analysis of Continua (3) Prerequisite: ENAE 652. Finite element formulation of nonlinear and time dependent processes. Introduction to tensors, nonlinear elasticity, plasticity and creep. Application to nonlinear continua including aerospace structures, shells, radiation heat transfer, creep.

ENAE 655 Structural Dynamics I (3) Prerequisites: MATH 246 and ENAE 452 or equivalents: or consent of instructor. Advanced principles of dynamics necessary for structural analysis; solutions of eigenvalue problems for discrete and continuous elastic systems, solutions to forced response boundary value problems by direct, modal, and transform methods.

ENAE 656 Structural Dynamics II (3) Prerequisite: ENAE 655 or consent of instructor. Topics in aeroelasticity: wing divergence; aileron reversal; flexibility effects on aircraft stability derivatives; wing, empennage and aircraft flutter; aircraft gust response.

ENAE 657 Theory of Structural Stability (3) Prerequisite: ENAE 451 or equivalent. Static and dynamic stability of structural systems. Classification of leading systems: linear and nonlinear post—buckling behavior. Perfect and imperfect system behavior. Buckling and failure of columns and plates.

ENAE 661 Advanced Propulsion (3) Prerequisites: ENAE 461, 462. Special problems of thermodynamics and dynamics of aircraft power plants; jet, rocket and ramjet engines; plasma, ion and nuclear propulsion for space vehicles.

ENAE 662 Advanced Propulsion (3) Prerequisites: ENAE 461, 462. Special problems of thermodynamics and dynamics of aircraft power plants; jet, rocket and ramjet engines; plasma, ion and nuclear propulsion for space vehicles.

ENAE 671 Aerodynamics of Incompressible Fluids (3) Prerequisite: MATH 463 or permission of instructor. Fundamental equations in fluid mechanics, irrotational motion, circulation theory of lift, thin airfoil theory, lifting line theory, wind tunnel corrections, perturbation methods.

ENAE 672 Aerodynamics of Incompressible Fluids (3) Prerequisite: MATH 463 or permission of instructor. Fundamental equations in fluid mechanics, irrotational motion, circulation theory of lift, thin airfoil theory, lifting line theory, wind tunnel corrections, perturbation methods.

ENAE 673 Aerodynamics of Compressible Fluids (3) Prerequisite: ENAE 472 or permission of instructor. One dimensional flow of a perfect compressible fluid. Shock waves. Two—dimensional linearized theory of compressible flow. Two—dimensional transonic and hypersonic flows. Exact solutions of two—dimensional isotropic flow Linearized theory of three—dimensional potetial flow. Exact solution of axially symmetrical potential flow. One-dimensional flow with friction and heat addition.

ENAE 674 Aerodynamics of Compressible Fluids (3) Prerequisite: ENAE 472 or permission of instructor. One dimensional flow of a perfect compressible fluid. Shock waves. Two—dimensional linearized theory of compressible flow. Two—dimensional transonic and hypersonic flows. Exact solutions of two—dimensional isotropic flow. Linearized theory of three—dimensional

potetial flow. Exact solution of axially symmetrical potential flow. One—dimensional flow with friction and heat addition.

ENAE 675 Aerodynamics of Viscous Fluids (3) Derivation of Navier Stokes equations, some exact solutions: boundary layer equations. Laminar flow-similar solutions, compressibility, transformations, analytic approximations, numerical methods, stability and transition of turbulent flow. Turbulent flow-isotropic turbulence, boundary layer flows, free mixing flows.

ENAE 676 Aerodynamics of Viscous Fluids (3) Derivation of Navier Stokes equations, some exact solutions: boundary layer equations. Laminar flow-similar solutions, compressibility, transformations, analytic approximations, numerical methods, stability and transition to turbulent flow. Turbulent flow-istropic turbulence, boundary layer flows, free mixing flows.

ENAE 688 Seminar (1–3)

ENAE 757 Advanced Structural Dynamics (3) Prerequisite: ENAE 655 or equivalent. Fundamentals of probability theory pertinent to random vibrations, including correlation functions, and spectral densities; example random processes; response of single degree and multidegree of freedom systems.

ENAE 788 Selected Topics in Aerospace Engineering (1–3)

ENAE 799 Master's Thesis Research (1–6)

ENAE 899 Doctoral Dissertation Research (1–8)

Agricultural and Extension Education Program

Chairman: Nelson
Professor: Longest
Associate Professors: Seibel, Whaples, Wheatley, Wright
Assistant Professors: Cooper, Ewert, Klavon, Glee

As a multidisciplinary department of several educational and social science specialities, the Department of Agricultural and Extension Education services the academic and continuing education needs and interests of the Cooperative Extension Service, teachers of agriculture and professionals involved in continuing education, community development, and environmental education.

Admission and Degree Information

The Master of Science and Doctor of Philosophy degree and the Advanced Graduate Specialist Certificate (requiring 30 credits beyond the master's degree) may be obtained in options in Agricultural Education, Environmental Education, Extension and Continuing Education, and Community Development. Specialization options in Agricultural Education include teacher education, research and administration and supervision. Specialization options under Extension and Continuing Education include staff development, program development, administration and supervision, and continuing education. The multidisciplinary Community Development program specialties include various social science disciplines with research, teaching, and extension functions; human and organizational planning and development; and public affairs education.

In the Master of Science programs both thesis and non-thesis options are available. Applicants for the Master of Science program must present transcripts and recommendations for evaluation.

No specific number of credits is required for the Doctor of Philosophy degree. Each student's program is planned by his committee according to his previous education and experience, special interests and needs, and professional plans. No foreign language is required but is encouraged for those interested in international development areas. Students are encouraged to develop research techniques through specific courses and participation in Department research programs.

Applicants should present results of the Miller Analogies and/or GRE tests with their applications for admission, along with recommendations from individuals competent to evaluate academic strengths of the applicant.

Courses

RLED 423 Extension Communications (3) An introduction to communications in teaching and within an organization, including barriers to communication, the diffusion process and the application of communication principles person to person, with groups and through mass media.

RLED 426 Development and Management of Extension Youth Programs (3) Designed for present and prospective state leaders of extension youth programs. Program development, principles of program management, leadership development and counseling; science, career selection and citizenship in youth programs, field experience in working with low income families' youth, urban work.

RLED 427 Group Dynamics in Continuing and Extension Education (3) Concepts involved in working with groups planning extension and continuing education programs. Analysis of group behavior and group dynamics related to small groups and development of a competence in the selection of appropriate methods and techniques.

RLED 464 Rural Life in Modern Society (3) Examination of the many aspects of rural life that affect and are affected by changes in technical, natural and human resources. Emphasis is placed on the role which diverse organizations, agencies and institutions play in the education and adjustment of rural people to the demands of modern society.

RLED 466 Rural Poverty in an Affluent Society (3) Topics examined include conditions under which people in poverty exist, factors giving rise to such conditions, problems faced by the rural poor, and the kinds of assistance they need to rise out of poverty. Topics and issues are examined in the context of rural-urban interrelationships and their effects on rural poverty. Special attention is given to past and present programs designed to alleviate poverty and to considerations and recommendations for future action.

RLED 487 Conservation of Natural Resources (3) Designed primarily for teachers. Study of state's natural resources—soil, water, fisheries, wildlife, forests, and minerals—natural resources problems and practices. Extensive field study. Concentration on subject matter. Taken concurrently with RLED 497 in summer season.

RLED 488 Critique in Rural Education (1) Current problems and trends in rural education.

RLED 489 Critique in Rural Education (1) Current problems and trends in rural education.

RLED 497 Conservation of Natural Resources (3) Designed primarily for teachers. Study of state's natural resources—soil, water, fisheries, wildlife, forests, and minerals—natural resources problems and practices. Extensive field study. Methods of teaching conservation included. Taken concurrently with RLED 487 in summer season.

RLED 499 Special Problems (1–3) Prerequisite: Staff approval.

RLED 606 Program Planning and Evaluation in Agricultural Education (2–3) Second semester Analysis of community agricultural education needs, selection and organization of course content, criteria and procedures for evaluating programs.

RLED 626 Program Development in Extension Education (3) Concepts in program planning and development. A conceptual approach to a tested framework for programming. Study and analysis of program design and implimentation in the extension service.

RLED 627 Program Evaluation in Adult and Continuing Education (3) Prerequisite: RLED 626 or consent of instructor An analysis of program evaluation concepts as they relate specifically to adult continuing education. Program evaluation concepts, issues and problems with emphasis on the use of evaluation procedures.

RLED 628 Seminar in Program Planning (1–5) The student assists in the development of an educational program in an institutional or community setting He also develops an individualized unit of study applicable to the program. Seminar sessions are based on the actual problems of diagnosing needs, planning, conducting, and evaluating programs. Repeatable to a maximum of five credits.

RLED 630 Teaching-Learning in Adult and Continuing Education (3) The teaching/learning process in adult continuing education. Instructional techniques and methodologies appropriate for adults The curriculum development process. Issues and priorities in adult continuing education.

RLED 642 Continuing Education in Extension (3) Studies the process through which adults have and use opportunities to learn systematically under the guidance of an agent, teacher or leader A variety of program areas will be reviewed giving the student an opportunity to plan, conduct and evaluate learning activities for adults.

RLED 661 Rural Community Analysis (3) First semester. Analysis of structure and function of rural society and application of social understandings to educational processes.

RLED 663 Developing Rural Leadership (2–3) First semester. Theories of leadership are emphasized. Techniques of identifying formal and informal leaders and the development of rural lay leaders.

RLED 691 Research Methods in Rural Education (2–3) First semester. The scientific method, problem identification, survey of research literature, preparing research plans, design of studies, experimentation, analysis of data and thesis writing.

RLED 699 Special Problems (1–3) Prerequisite: Approval of staff.

RLED 707 Supervision of Student Teaching (1) Summer session. Identification of experiences and activities in an effective student teaching program, responsibilities and duties of supervising teachers, and evaluation of student teaching.

RLED 789 Special Topics (1–3) May be repeated to a maximum of nine credits provided content is different.

RLED 798 Seminar in Rural Education (1–3) Problems in the organization, administration, and supervision of the several agencies of rural and/or vocational education. Repeatable to a maximum of eight semester credits.

RLED 799 Master's Thesis Research (1–6)

RLED 882 Agricultural College Instruction (1)

RLED 899 Doctoral Dissertation Research (1–8)

Agricultural and Resource Economics Program

Professor and Chairman: Norton
Professors: Bender, Cain, Foster, Ishee, Lessley, Moore, Smith, Stevens, Tuthill, Wysong
Associate Professors: Hardie, Lawrence, McConnell
Assistant Professors: Chambers, Prindle, Strand

The Department of Agricultural and Resource Economics offers a course of study leading to the degrees of Master of Science and Doctor of Philosophy. The graduate program prepares students through courses in traditional subject matter areas, research experiences designed to

give competency in scientific methodology, and seminar and discussion opportunities.

The Department provides two areas of specialization, agricultural economics and resource economics. Areas of study and research in agricultural economics include agricultural development, international trade, agricultural marketing, farm management and production economics, agricultural policy and econometrics. Resource economics areas cover land use, marine resources, water resources, and community and resource development. Both areas of specialization integrate opportunity for study and research from a variety of disciplines related to agricultural and resource economics.

Admission and Degree Information

Thesis and non-thesis options are available for the Master of Science degree in both areas of specialization. The thesis option requires a minimum of 24 hours course work and six hours of thesis. The final examination is oral, takes place after completion of the thesis and is primarily a defense of the thesis. The non-thesis option requires 33 hours of course work, including a scholarly paper. There is a final comprehensive written examination for the non-thesis option. The examination is primarily concerned with course work taken during the program.

Students with a bachelor's degree generally enter the master's program before applying for the doctoral program. A minimum of 48 hours of course work beyond the bachelor's degree and 12 hours of dissertation research are required for the Ph.D. degree. Qualifying examinations are administered on completion of core course requirements, and written and oral comprehensive examinations are held when course work has been completed. An oral dissertation defense is also required.

There is no foreign language requirement for any graduate degree. The time required to complete a master's degree is generally two years, although it can be completed in 18 months of concentrated effort. The Ph.D. adds a minimum of two years beyond the Master's program. The Graduate Record Examination (GRE) Aptitude Test scores are required with the application for admission.

Facilities and Special Resources

The Department actively employs the resources of many state, federal, and international agencies unique to the Washington, D.C. area to offer experience from the world of government and business. The Library of Congress in Washington and the National Agricultural Library in Beltsville (just north of the campus) enhance teaching and research efforts.

Financial Assistance

Graduate assistantships are offered to qualified applicants on the basis of past academic performance and availability of funds. A large portion of the full-time students in the Department hold assistantships or some other form of financial aid. Part-time and summer work is often available for students not receiving financial aid.

Additional Information

A booklet, *Curriculum,* of the Department describes undergraduate and graduate programs, and gives a description of all courses given by the Department. *DARE Policy Handbook for the Graduate Program* provides course requirements, examination procedures and descriptive material on M.S. and Ph.D. programs in both areas of specialization. For more specific information, contact:

Dr. B.V. Lessley
Graduate Coordinator
Department of Agricultural and Resource Economics

Courses

AREC 404 Prices of Agricultural Products (3) An introduction to agricultural price behavior. Emphasis is placed on the use of price information in the decision-making process, the relation of supply and demand in determining agricultural prices, and the relation of prices to grade, time, location, and stages of processing in the marketing system. The course includes elementary methods of price analysis, the concept of parity and the role of price support programs in agricultural decisions.

AREC 406 Farm Management (3) The organization and operation of the farm business to obtain an income consistent with family resources and objectives. Principles of production economics and other related fields are applied to the individual farm business. Laboratory period will be largely devoted to field trips and other practical exercises.

AREC 407 Financial Analysis of the Farm Business (3) Application of economic principles to develop criteria for a sound farm business, including credit source and use, preparing and filing income tax returns, methods of appraising farm properties, the summary and analysis of farm records, leading to effective control and profitable operation of the farm business.

AREC 410 Horse Industry Economics (3) Prerequisite: ANSC 230 and 232. An introduction to the economic forces affecting the horse industry and to the economic tools required by horse farm managers, trainers, and others in the industry.

AREC 414 Introduction to Agricultural Business Management (3) The different forms of businesses are investigated. Management functions, business indicators, measures of performance, and operational analysis are examined. Case studies are used to show applications of management techniques.

AREC 427 The Economics of Marketing Systems for Agricultural Commodities (3) Basic economic theory as applied to the marketing of agricultural products, including price, cost, and financial analysis. Current developments affecting market structure including effects of contractual arrangement, vertical integration, governmental policies and regulation.

AREC 432 Introduction to Natural Resources Policy (3) Development of natural resource policy and analysis of the evolution of public intervention in the use of natural resources. Examination of present policies and of conflicts between private individuals, public interest groups, and government agencies.

AREC 445 World Agricultural Development and the Quality of Life (3) An examination of the key aspects of the agricultural development of less developed countries related to resources, technology, cultural and social setting, population, infrastructure, incentives, education, and government. Environmental impact of agricultural development, basic economic and social characteristics of peasant agriculture, theories and models of agricultural development, selected aspects of agricultural development planning.

AREC 452 Economics of Resource Development (3) A study of the adequacy and quality of the natural (land, water, air) and human resources, the economic and institutional arrangements which guide their use and development, and the means for improving their quality and use.

AREC 453 Economic Analysis of Natural Resources (3) Rational use and reuse of natural resources. Theory and methodology of the allocation of natural resources among alternative uses. Optimum state of conservation, market failure, safe minimum standard, and cost-benefit analysis.

AREC 484 Introduction to Econometrics in Agriculture (3) An introduction to the application of econometric techniques to agricultural problems with emphasis on the assumptions and computational techniques necessary to derive statistical estimates, test hypotheses, and make predictions with the use of single equation models. Includes linear and non-linear regression models, internal least squares, discriminant analysis and factor analysis.

AREC 489 Special Topics in Agricultural and Resources Economics (3) Repeatable to a maximum of 9 credits.

AREC 495 Honors Reading Course in Agricultural and Resource Economics I (3) Prerequisite: Acceptance in the honors program of the Department of Agricultural and Resource Economics. Selected readings in political and economic theory from 1700 to 1850. This course develops a basic understanding of the development of economic and political thought as a foundation for understanding our present society and its cultural heritage.

AREC 496 Honors Reading Course in Agricultural and Resource Economics II (3) Prerequisite: Successful completion of AREC 495 and registration in the honors program of the Department and resource economics. Selected readings in political and economic theory from 1850 to the present. This couse continues the development of a basic understanding of economic and political thought begun in AREC 495 by the examination of modern problems in agricultural and resource economics in the light of the material read and discussed in AREC 495 and AREC 496.

AREC 639 Internship in Resource Management (2–4) Prerequisite: Permission of major advisor and department chairman. open only to graduate students in the AREC resource management curriculum. Repeatable to a maximum of four hours.

AREC 685 Applications of Mathematical Programming in Agriculture Business and Analysis (3) Prerequisites: ECON 403 or consent of instructor. The application of mathematical programming to solve a wide variety of problems in agriculture, business and economics. Emphasis on modeling large-scale systems and interpreting results.

AREC 689 Special Topics in Agricultural and Resource Economics (3) First and second semester. Subject matter taught will be varied and will depend on the persons available for teaching unique and specialized phases of agricultural and resource economics. The course will be taught by the staff or visiting agricultural and resource economists who may be secured on lectureship or visiting professor basis.

AREC 698 Seminar (1) First and second semesters. Students will participate through study of problems in the field, reporting to seminar members and defending positions adopted. Outstanding leaders in the field will present ideas for analysis and discussion among class members. Students involved in original research will present progress reports. Class discussion will provide opportunity for constructive criticism and guidance.

AREC 699 Special Problems in Agricultural and Resource Economics (1–2) First and second semesters and summer. Intensive study and analysis of specific problems in the field of Agricultural and Resource Economics, which provide information in depth in areas of special interest to the student.

AREC 799 Master's Thesis Research (1–6)

AREC 804 Advanced Agricultural Price and Demand Analysis (3) Second semester. An advanced study in the theory of: (1) the individual consumer, (2) household behavior, and (3) aggregate demand. The concepts of price and cross elasticities of demand, income elasticity of demand, and elasticity of substitution will be examined in detail. The use of demand theory in the analysis of welfare problems, market equilibrium (with special emphasis on trade) and the problem of insufficient and excessive aggregate demand will be discussed.

AREC 806 Economics of Agricultural Production (3) First semester. Study of the more complex problems involved in the long-range adjustments, organization and operation of farm resources, including the impact of new technology and methods. Applications of the theory of the firm, linear programming, activity analysis and input-output analysis.

AREC 824 Food Distribution Management (3) Theory and practice of the complex functional and institutional aspects of food distribution systems analyzed from the perspective of management decision-making in the food industry. Possible long-range economic effects of current structural adjustments: social and ecological aspects of food industry management decision-making.

AREC 832 Agricultural Price and Income Policy (3) Second semester, alternate years, 1973. The evolution of agricultural policy in the United States, emphazing the origin and development of United St governmental programs, and their effects upon agricultural production, prices and income.

AREC 844 International Agriculture Trade (3) Economic theory, policies and practices in international trade in agricultural products. Principal theories of international trade and finance, agricultural trade policies of various countries, and agricultural trade practices.

AREC 845 Agriculture in World Economic Development (3) First semester, alternate years, 1972. Theories and concepts of what makes economic development happen. Approaches and programs for stimulating the transformation from a primitive agricultural economy to an economy of rapidly developing commercial agriculture and industry. Analysis of selected agricultural development programs in Asia, Africa and Latin America

AREC 852 Advanced Resource Economics (3) Second semester, alternate years. Assessment and evaluation of our natural, capital, and human resources; the use of economic theory and various techniques to guide the allocation of these resources within a comprehensive framework; and the institutional arrangements for using these resources. ECON 403 or equivalent is a prerequisite.

AREC 883 Agricultural and Resource Economics Research Techniques (3) First semester. Emphasis is given to philosophy and basic objectives of research in the field of Agricultural and Resource Economics. The course is designed to help students define a research problem and work out logical procedures for executing research in the social sciences. Attention is given to the techniques and tools available to Agricultural and Resource Economics. Research documents in the field will be appraised from the standpoint of procedures and evaluation of the search.

AREC 899 Doctoral Dissertation Research (1–8)

Agricultural Engineering Program

Associate Professor and Chairman: Stewart
Professors: Wheaton, Harris
Associate Professors: Grant, Felton
Assistant Professors: Ayars, Farsaie, Frey, Johnson, Lawson, Yaramanoglu

The Department of Agricultural Engineering offers a graduate program of study with specialization in either agricultural or aquacultural engineering leading to the degree of Master of Science and Doctor of Philosophy. Courses and research problems place emphasis on the engineering aspects of the production, harvesting, processing and marketing of terrestrial and aquatic food and fiber products. Concern for the conservation of land and water resources and the utilization and/or disposal of byproducts associated with biological systems is included in order to maintain and enhance the quality of our environment while contributing to efficient production of food and fiber to meet increasing population demands.

Admission and Degree Information

Admission is open to B.S. graduates in engineering, physical science or biological science who meet graduate school requirements and who have satisfactorily completed a core of basic engineering courses. For the M.S. program, a minimum of 30 semester hours are required of which at least 9 hours will be agricultural engineering courses, 6 hours will be thesis research and 3 hours will be biometrics.

A minimum of 60 credit hours beyond a B.S. are required for the Ph.D. program of which 12 hours will be thesis research and 3 hours will be biometrics.

Only the thesis option is available for the M.S. and Ph.D. degrees. The Department has no language requirements for either graduate degree. Except for the above requirements a M.S. or Ph.D. program is planned on a personal basis and is oriented toward the intellectual and professional objectives of the student.

Facilities and Special Resources

In addition to well-equipped laboratories in the Department, the facilities of the Agricultural Experiment Station, the Computer Science Center, and the College of Engineering are available. The new University of Maryland Center for Environmental and Estuarine Studies enhances the aquacultural phase of the Department's graduate program.

Financial Assistance

Financial assistance may be available to qualified candidates.

Additional Information

For additional information contact:
Chairman
Agricultural Engineering Department

Courses

ENAG 401 Agricultural Production Equipment (3) Two lectures and one laboratory per week. Prerequisite: AGEN 100. Principles of operation and functions of power and machinery units as related to tillage; cutting, conveying, and separating units; and control mechanisms. Principles of internal combustion engines and power unit components.

ENAG 402 Agricultural Materials Handling and Environmental Control (3) Two lectures and one laboratory per week. Prerequisite: AGEN 100. Characteristics of construction materials and details of agricultural structures. Fundamentals of electricity, electrical circuits, and electrical controls. Materials handling and environmental requirements of farm products and animals.

ENAG 421 Power Systems (3) Two lectures and one two hour laboratory per week. Prerequisites: ENME 216, ENEE 300 and ENME 340. Analysis of energy conversion devices including internal combustion engines, electrical and hydraulic motors. Fundamentals of power transmission and coordination of power sources with methods of power transmission.

ENAG 422 Soil and Water Engineering (3) Three lectures per week. Prerequisite: ENME 340. Applications of engineering and soil sciences in erosion control, drainage, irrigation and watershed management. Principles of agricultural hydrology and design of water control and conveyance systems.

ENAG 424 Functional and Environmental Design of Agricultural Structures (3) Two lectures and one hour laboratory per week. Prerequisite: AGEN 324. An analytical approach to the design and planning of functional and environmental requirements of plants and animals in semi-or completely enclosed structures.

ENAG 432 General Hydrology (3) Qualitative aspects of basic hydrologic principles pertaining to the properties, distribution and circulation of water as related to public interest in water resources.

ENAG 433 Engineering Hydrology (3) Prerequisite: MATH 246, ENCE 330 or ENME 340. Properties, distribution and circulation of water from the sea and in the atmosphere emphasizing movement overland, in channels and through the soil profile. Qualitative and quantitative factors are considered.

ENAG 435 Aquacultural Engineering (3) Prerequisite: Consent of department. A study of the engineering aspects of development, utilization and conservation of aquatic systems. Emphasis will be on harvesting and processing aquatic animals or plants as related to other facets of water resources management.

ENAG 444 Functional Design of Machinery and Equipment (3) Two lectures and one two-hour laboratory per week. Prerequisite: ENES 221 and senior standing. Theory and methods of agricultural machine design. Application of machine design principles and physical properties of soils and agricultural products in designing machines to perform specific tasks.

ENAG 454 Biological Process Engineering (3) Prerequisite: ENME 342. Design of systems to pump, heat, cool, dry and control biological materials as part of food and agricultural engineering. Study the effect of physical parameters on biological material response to these processes

ENAG 488 Topics in Agricultural Engineering Technology (1–3) Prerequisite: Permission of the instructor. Selected topics in Agricultural Engineering technology of current need and interest. May be repeated to a maximum of six credits if topics are different. Not acceptable for credit towards major in Agricultural Engineering.

ENAG 489 Special Problems in Agricultural Engineering (1–3) Prerequisite: Approval of department. Student will select an engineering problem and prepare a technical report. The problem may include design, experimentation, and/or data analysis.

ENAG 499 Special Problems in Agricultural Engineering Technology (1–3) Prerequisite: Approval of department. Not acceptable for majors in Agricultural Engineering. Problems assigned in proportion to credit.

ENAG 601 Instrumentation Systems (3) Prerequisite: Approval of department. Analysis of instrumentation requirements and techniques for research and operational agricultural or biological systems.

ENAG 602 Mechanical Properties of Biological Materials (3) Prerequisite: Differential equations a study of the significance and the utilization of the mechanical properties of biological materials under various conditions of loading. Emphasis on particle motion; relationships between stress and strain, force, velocity and acceleration; principles of work and energy, and theories of failure.

ENAG 612 Similitude in Agricultural Engineering (3) Prerequisites: ENCE 350 and either ENME 342 or ENCE 330, or consent of instructor. Application and use of dimensional and model analysis for studying mechanical, structural, and fluid systems encountered in Agricultural Engineering

ENAG 631 Land and Water Resource Development Engineering (3) Prerequisite: ENAG 422 or approval of department. A comprehensive study of engineering aspects of orderly development for land and water resources. Emphasis on project formulation, data acquisition, project analysis and engineering economy

ENAG 642 Engineering Dynamics of Biological Systems (3) Prerequisite: AGEN 454 or equivalent. Description of the physical state of a biological system using geometry, physical properties and forces. Discussion of important interrelationships, measurement techniques and resulting transport processes as applied to biological process engineering.

ENAG 688 Advanced Topics in Agricultural Engineering (1–4) Prerequisite: Consent of instructor. Advanced topics of current interest in the various areas of agricultural engineering. Maximum eight credits.

ENAG 698 Seminar (1) cr First and second semesters.

ENAG 699 Special Problems in Agricultural and Aquacultural Engineering (1–6) First and second semester and summer school. Work assigned in proportion to amount of credit.

ENAG 799 Master's Thesis Research (1–6)

ENAG 899 Doctoral Dissertation Research (1–8)

Agronomy Program

Professor and Chairman: Miller
Professors: Axley, Aycock, Bandel, Decker, Fanning, Foss F.P. Miller, Strickling
Associate Professor: Mulchi
Assistant Professors: Glenn, Inman, Kenworthy, McIntosh, Sammons, Weil, Wiebold

The Department of Agronomy offers graduate courses of study leading to the degrees of Master of Science and Doctor of Philosophy. The student may pursue major work in the crops division or in the soils division of the Department. Programs are offered in cereal crop production, forage management, turf management, plant breeding, tobacco production, crop physiology, weed science, soil chemistry, soil physics, soil fertility, soil and water conservation, soil classification, soil survey and land use, soil mineralogy, soil biochemistry, soil microbiology, air pollution, waste disposal, and soil environment interactions.

Admission and Degree Information

Thesis and non-thesis options are available for the Master of Science degree. A bachelor's degree in Agronomy is not required if the student has adequate training in the basic sciences. All students must complete the Master of Science degree before admission to the doctoral program. Departmental regulations have been assembled for the guidance of candidates for graduate degrees. Copies of these regulations are available from the Department of Agronomy.

Facilities and Special Resources

The Agronomy Department has over 20 well-equipped laboratories to carry out basic and applied research in crop and soil science. Basic equipment in the laboratories include: X-ray diffraction and spectrophotometer, gas chromatograph, isotope counters, petrographic microscopes, neutron soil moisture probe and scaler, and carbon furnace. Growth chambers, extensive greenhouse space, and five research farms permit a wide range of environmental conditions for research into plant growth processes. A computer center, located on campus, is available for use by the Department. The University and the New National Agricultural Sciences Libraries, supplemented by the Library of Congress, make the library resources among the best in the nation. Many projects of the Department are conducted in cooperation with the Agricultural Research Service of the United States Department of Agriculture with headquarters located three miles from the campus.

Financial Assistance

A limited number of research assistantships and teaching assistantships are available for qualified applicants.

Courses

AGRO 403 Crop Breeding (3) Prerequisite: BOTN 414 or ZOOL 246. Principles and methods of breeding annual self and cross-pollinated plant and perennial forage species.

AGRO 404 Tobacco Production (3) Prerequisite: BOTN 100. A study of the history, adaptation, distribution, culture, and improvement of various types of tobacco, with special emphasis on problems in Maryland tobacco production. Physical and chemical factors associated with yield and quality of tobacco will be stressed.

AGRO 405 Turf Management (3) Two lectures and one laboratory period per week. Prerequisite: BOTN 100. A study of principles and practices of managing turf for lawns, golf courses, athletic fields, playgrounds, airfields and highways for commerical sod production.

AGRO 406 Forage Crop Production (3) Prerequisites: BOTN 101, and AGRO 100; or concurrent enrollment in these courses. A general look at world grasslands; production and management requirements of major grasses and legumes for quality hay, silage and pasture for livestock feed; new cultivar development and release; seed production and distribution of improved cultivars.

AGRO 407 Cereal and Oil Crops (3) Prerequisites: BOTN 101 and AGRO 100; or concurrent enrollment in these courses. A study of principles and practices of corn, small grains, rice, millets, sorghums, and soybeans and other oil seed crops. A study of seed production, processing, distribution and federal and state seed control programs of corn, small grains and soybeans.

AGRO 411 Soil Fertility Principles (3) Prerequisite: AGRO 202. A study of the chemical, physical, and biological characteristics of soils that are important in growing crops. Soil deficiencies of physical, chemical, or biological nature and their correction by the use of lime, fertilizers, and rotations are discussed and illustrated.

AGRO 412 Commercial Fertilizers (3) Prerequisite: AGRO 202 or permission of instructor. A study of the manufacturing of commercial fertilizers and their use in soils for efficient crop production.

AGRO 413 Soil and Water Conservation (3) Two lectures and one laboratory period a week. Prerequisite: AGRO 202 or permission of instructor. A study of the importance and causes of soil erosion, methods of soil erosion control, and the effect of conservation practices on soil-moisture supply. Special emphasis is placed on farm planning for soil and water conservation. The laboratory period will be largely devoted to field trips.

AGRO 414 Soil Classification and Geography (4) Three lectures and one laboratory period a week. Prerequisite: AGRO 202 or permission of instructor. Processes and factors of soil genesis. Taxonomy of soils of the world by U.S. System. Laboratory covers soil morphological characteristics, composition, classification, survey and field trips to examine and describe soils.

AGRO 415 Soil Survey and Land Use (3) Prerequisite: AGRO 302. Evaluation of soils in the uses of land and the environmental implications of soil utilization. Interpretation of soil information and soil surveys as applied to both agricultural and non-agricultural problems. Incorporation of soil data into legislation, environmental standards and land use plans.

AGRO 417 Soil Physics (3) Two lectures and one laboratory period a week. Prerequisite: AGRO 202 and a course in physics, or permission of instructor. A study of physical properties of soils with special emphasis on relationship to soil productivity.

AGRO 421 Soil Chemistry (3) One lecture and two laboratory periods a week. Prerequisite: AGRO 202 or permission of instructor. A study of the chemical composition of soils; cation and anion exchange; acid, alkaline and saline soil conditions; and soil fixation of plant nutrients. Chemical methods of soil analysis will be studied with emphasis on their relation to fertilizer requirements.

AGRO 422 Soil Biochemistry (3) Two lectures and one laboratory period a week. Prerequisite: AGRO 202, CHEM 104 or consent of instructor. A study of biochemical processes involved in the formation and decomposition of organic soil constitutents. Significance of soil-biochemical processes involved in plant nutrition will be considered.

AGRO 423 Soil-Water Pollution (3) Prerequisite: AGRO 302 and CHEM 104 or permission of instructor. Reaction and fate of pesticides, agricultural fertilizers, industrial and animal wastes in soil and water with emphasis on their relation to the environment.

AGRO 451 Cropping Systems (2) Prerequisite: AGRO 102 or equivalent. The coordination of information from various courses in the development of balanced cropping systems, appropriate to different objectives in various areas of the state and nation.

AGRO 453 Weed Control (3) Two lectures and one laboratory period a week. Prerequisite: AGRO 102 or equivalent A study of the use of cultural practices and chemical herbicides in the control of weeds.

AGRO 499 Special Problems in Agronomy (1–3) Prerequisites: AGRO 202, 406, 407 or permission of instructor. A detailed study, including a written report of an important problem in agronomy.

AGRO 601 Advanced Crop Breeding (2) Alternate years (offered 1973–74). Prerequisite: AGRO 403 or equivalent. Genetic, cytogenetic, and statistical theories underlying methods of plant breeding. A study of quantitative inheritance, herterosis, heritability, interspecific and intergeneric hybridization, polyploidy, sterility mechanisms, inbreeding and outbreeding, and other topics as related to plant breeding.

AGRO 602 Advanced Crop Breeding (2) Alternate years (offered 1973–74.) Prerequisite: AGRO 601 or equivalent. Genetic, cytogenetic, and statistical theories underlying methods of plant breeding. A study of quantitative inheritance, herterosis, heritability, interspecific and intergeneric hybridization, polyploidy, sterility mechanisms, inbreeding and outbreeding, and other topics as related to plant breeding.

AGRO 608 Research Methods (2) Second semester. Prerequisite: Permission of staff. Development of research viewpoint by detailed study and report on crop research of the Maryland Experiment Station or review of literature on specific phases of a problem.

AGRO 722 Advanced Soil Chemistry (3) Second semester, alternate years (offered 1972–73.) One lecture and two laboratory periods a week. Prerequisites: AGRO 202 and permission of instructor. A continuation of AGRO 421 with emphasis on soil chemistry of minor elements necessary for plant growth.

AGRO 789 Recent Advances in Agronomy (2–4) First semester. Two hours each year. Total credit four hours. Prerequisite: Permission of instructor. A study of recent advances in Agronomy research.

AGRO 798 Agronomy Seminar (1) First and second semesters. Total credit toward Master of Science degree, 2; toward Ph.D. degree, 6. Prerequisite: Permission of instructor.

AGRO 799 Master's Thesis Research (1–6)

AGRO 802 Breeding for Resistance to Plant Pests (3) Second semester, alternate years (offered 1972–73.) Prerequisites: ENTM 252, BOTN 221, AGRO 403, or permission of instructor. A study of the development of breeding techniques for selecting and utilizing resistance to insects and diseases in crop plants and the effect of resistance on the interrelationships of host and pest.

AGRO 804 Technic in Field Crop Research (2) Second semester, alternate years (offered 1972–73.) Field plot technique, application of statistical analysis to agronomic data, and preparation of the research project.

AGRO 805 Factors Affecting Crop Yields (2) Prerequisites: BOTN 441 or BOTN 641 plus advanced training in plant sciences. Major emphasis will be on physiological processes affecting yield and productivity of major food liber and industrial crops of the world. Topics such as photosynthesis, respiration, photorespiration, nitrogen metabolism will be related to crop growth as affected by management decisions. Topics of discussion will also include growth analysis and the use of computer modeling of crop growth by plant scientists.

AGRO 806 Herbicide Chemistry and Physiology (2) Second semester, alternate years (offered 1972–1973.) Prerequisite: AGRO 453 and CHEM 104 or permission of instructor. Two lectures a week. The importance of chemical structure in relation to biologically significant reactions will be emphasized in more than 10 different herbicide groups. Recent advances in herbicidal metabolism, translocation, and mode of action will be reviewed. Adsorption, decomposition and movement in the soil will also be studied.

AGRO 807 Advanced Forage Crops (2) First semester, alternate years (offered 1972–1973.) Prerequisite: BOTN 441 or equivalent, or permission of instructor. A fundamental study of physiological and ecological responses of grasses and legumes to environmental factors, including fertilizer elements, soil moisture, soil temperature, humidity, length of day, quality and intensity of light, wind movement, and defoliation practices. Relationship of these factors to life history, production, chemical and botanical composition, quality, and persistence of forages will be considered.

AGRO 821 Advanced Methods of Soil Investigation (3) First semester, alternate years (offered 1973–1974.) Prerequisites: AGRO 202 and permission of instructor. An advanced study of the theory of the chemical methods of soil investigation with emphasis

on problems involving application of physical chemistry.

AGRO 831 Soil Mineralogy (4) Soil minerals, with emphasis on clay minerals, are studied from the viewpoint of soil genesis and physical chemistry. Mineralogical analyses by X-ray and chemical techniques.

AGRO 832 Advanced Soil Physics (3) Second semester, alternate years (offered 1973–1974.) Prerequisites: AGRO 202 and permission of instructor. An advanced study of physical properties of soils.

AGRO 899 Doctoral Dissertation Research (1–8)

American Studies Program

Professor and Director: Wise
Associate Director and Director of Graduate Studies: Kelly
Professors: Bode, Corrigan
Associate Professors: Lounsbury, Mintz, Pearson
Assistant Professors: Caughey, McCarthy
Adjunct Professor: Washburn

American Studies offers an interdisciplinary program of study leading to both the M.A. and Ph.D. Graduate students in the field take (1) courses in the various allied departments (e.g., Anthropology, Education, English, History, Journalism, Philosophy, Sociology), and (2) integrating courses in the core program taught by the core American Studies faculty.

All students take the introductory graduate proseminar—focused on the history, theory, and methodology of American culture studies. Other graduate seminars vary from semester to semester—sometimes concentrating on a cultural time period (e.g., ante-Bellum America, the 1930's, the 1960's), a particular mode of cultural expression (e.g., film, material culture, popular culture), an individual with special cultural resonance (e.g., Mencken), or a particular theme or movement (e.g., education in American culture, literature considered in cultural context). A special cooperative venture enables students interested in material culture to take substantial course work at the Smithsonian Institution.

Admission and Degree Information

Master's candidates normally undertake a full year of course work (30 semester hours). All candidates are required to take at least 12 hours of core American Studies seminars—6 hours of AMST 618, and 6 hours of AMST 628 and 629. In addition, candidates select an area of concentration from courses offered in allied departments—Anthropology, Architecture, Art, Economics, Education, English, Geography, Government and Politics, History, Journalism, Music, Philosophy, Psychology, Sociology, Speech and Dramatic Arts.

Before receiving the M.A., candidates take a comprehensive examination evaluating their ability to integrate various perspectives in the program. Research oriented candidates may choose to write a thesis in place of six hours of course credit.

Many students accepted for the doctoral program already have an M.A. in American Studies. Well-qualified candidates without an American Studies M.A. may be admitted to the doctoral program, but they may be required to make up background deficiencies.

Core program requirements for the Ph.D. are similar to those for the M.A.—12 hours of core American Studies courses, 6 at the 618 level and 6 in advanced seminars. The remainder of the student's course work is taken from courses in the allied departments, and in other core American Studies electives.

Ph.D. candidates must complete at least 30 semester hours beyond the M.A., including an 18-hour residency requirement. Candidates must also demonstrate proficiency in a tool (e.g., foreign language, computer science), must pass a comprehensive examination, and must write a dissertation based upon original research and interpretation.

Facilities and Special Resources

The proximity of many federal institutions allows for a firsthand appreciation of politics and contemporary life, while the facilities of the National Archives and the Library of Congress give the historian access to the materials documenting the experiences of past generations. Important galleries, including the National Collection of Fine Arts and the National Gallery of Art, exhibit the high points of creative expression in the visual arts. The holdings of the Smithsonian Institution possess numerous manifestations of the native vernacular traditions in architecture and technology, in the folk arts, and in American Indian culture. The District of Columbia and its surrounding regions represent an impressive aggregate of associations and communities—alternatives to traditional politics such as Common Cause, the focus upon black cultural identity found in the Anacostia Neighborhood Museum, the new cities of Columbia, Maryland and Reston, Virginia—which seek to transcend the crises of urban America in a creative manner.

The program, drawing upon the resources of its cultural environment, offers the individual an education in the most meaningful sense; a personal confrontation with academic tradition related to the processes of immediate and contemporary social change.

Financial Assistance

Some assistantships are available through the departments for *qualified graduate* students.

Additional Information

For additional information, please write to the Director of Graduate Studies, American Studies Program, University of Maryland.

Courses

AMST 426 Culture and the Arts in America (3) Prerequisite: Junior standing. A study of American institutions, the intellectual and esthetic climate from the colonial period to the present.

AMST 427 Culture and the Arts in America (3) Prerequisite: Junior standing. A study of American institutions, the intellectual and esthetic climate from the colonial period to the present.

AMST 436 Readings in American Studies (3) Prerequisite: Junior standing. An historical survey of American values as presented in various key writings.

AMST 437 Readings in American Studies (3) Prerequisite: Junior standing. An historical survey of American values as presented in various key writings.

AMST 446 Popular Culture in America (3) Prerequisite: Junior standing and permission of instructor. A survey of the historical development of the popular arts and modes of popular entertainment in America.

AMST 447 Popular Culture in America (3) Prerequisite: Junior standing and AMST 446. Intensive research in the sources and themes of contemporary American popular culture.

AMST 498 Special Topics in American Studies (3) Prerequisite: A course in American history, literature, or government, or consent of the instructor. Topics of special interest. Repeatable to a maximum of 6 credits when topics differ

AMST 618 Introductory Seminar in American Studies (3)

AMST 628 Seminar in American Studies (3)

AMST 629 Seminar in American Studies (3)

AMST 638 Orientation seminar-material aspects of American civilization (3) Class meets at the Smithsonian.

AMST 639 Reading course in selected aspects of American civilization (3) Class meets at the Smithsonian.

AMST 698 Directed Readings in American Studies (3) This course is designed to provide students with the opportunity to pursue independent, interdisciplinary research and reading in specific aspects of American culture under the supervision of a faculty member. Repeatable to a maximum of six credits.

AMST 799 Master's Thesis Research (1–6)

AMST 899 Doctoral Dissertation Research (1–8)

Animal Sciences Program

Professor and Program Chairman: Davis
Professors: (Animal Science) Flyger, Leffel, Young; (Dairy Science) Keeney, King, Mattick, Vandersall, Williams; (Veterinary Science) Hammond, Mohanty.
Associate Professors: (Animal Science) Buric, DeBarthe; (Dairy Science) Douglass, Westhoff; (Veterinary Science) Albert, Dutta, Marquardt.
Assistant Professors: (Animal Science) Hartsock, Kearn, Kunkle, Stricklin; (Dairy Science) Erdman, Majeskie, Mather, Peters, Vijay; (Veterinary Science) Davidson, Haaland, Nepote, Sapperstein.
Professors Emerite: Cairns, Greene
Adjunct Professor: Hawk
Adjunct Associate Professor: Paape

The Graduate Program in the Animal Sciences offers work leading to the degrees of Master of Science and Doctor of Philosophy. Both the thesis and non-thesis options are available for the Master's Degree. Areas of concentration within the Program include animal nutrition, physiology, genetics, management, pathology and virology for all of the classes and species of animals listed. Opportunities for study related to domestic animals, marine and wildlife are available.

Degrees with research specialities identified with meat, milk and other dairy products may be undertaken in this program or in the Graduate Program in Food Science, in which appropriate faculty of these Departments also participate.

Admission and Degree Information

Applicants are required to submit scores of the Graduate Record Examination.

One course at the graduate level in biochemistry and one in biometrics and two credits of program seminar are required for the M.S. Degree. Students enrolled in the non-thesis option are expected to defend their scholarly paper in an oral examination. Two academic years, including the summer for research, are usually required for completing the M.S. Entering students should have an academic background commensurate with a baccalaureate degree in the Animal Sciences. Those not hav-

ing a course in genetics, nutrition, general animal physiology, microbiology and animal production or management should plan to take such a course early in their graduate program.

Ph.D. students entering from other institutions with the Master's or entering directly into the Ph.D. program are expected to meet the requirements indicated above. Two additional credits in the program seminar are required. The M.S. is not a prerequisite for admission to Ph.D. study: however, most students find it advantageous. Students usually complete the Ph.D. in two years after the M.S.

Facilities and Special Resources

Faculty in the program are an outstanding group representing research accomplished in a wide variety of related fields. Excellent supporting courses in physiology, biochemistry and microbiology are available in the appropriate departments. Courses in biometrics listed in the catalog under AGRI provide a strong background in experimental design and statistical analysis. The Computer Science Center offers courses in programming and computer language, as well as facilities for the statistical analysis of thesis data.

Outstanding laboratory facilities are available in the Animal Sciences Center which includes the combined resources of the Departments of Animal, Dairy and Veterinary Science. Instrumentation is available to graduate students for gaslipid chromatography, atomic absorption spectrophotometry, automated calorimetry, electron microscopy, liquid scintillation radioactivity measurements, electrophoresis, ultra centrifugation and a variety of microbiological techniques. Controlled environment facilities in the Center permit work with laboratory animals and detailed experiments on larger animals. A gnotobiotic laboratory is available and currently being used in ruminent nutrition research. Excellent surgical facilities are available for research in the areas of reproductive and nutritional physiology.

Herds and flocks of beef cattle, dairy cattle, horses, sheep and swine are readily available for graduate research. Limited numbers of experiments can be conducted on the campus with large animals. Experiments requiring large numbers of animals are carried out at one of four outlying farms.

A cooperative agreement with the Agricultural Research Service at nearby Beltsville, Maryland (BARC) makes available laboratory, animal and research personnel resources of importance in the graduate program.

A dairy product processing facility is available for dairy product research.

In addition to excellent library facilities on the Campus, the National Agricultural Library, the National Library of Medicine and the Library of Congress, all located within 10 miles, constitute the best library resource for graduate study available anywhere.

Financial Assistance

A number of Graduate Assistantships are available and awarded to students presenting strong academic records and a capability and motivation to perform well in teaching or research assignments.

Additional Information

For specific information on the Program, admission procedures or financial aid, contact:

Dr. R.F. Davis, Chairman Department of Dairy Science

Courses

ANSC 401 Fundamentals of Nutrition (3) Prerequisite: CHEM 104; ANSC 212 recommended. A study of the fundamental role of all nutrients in the body including their digestion, absorption and metabolism. Dietary requirements and nutritional deficiency syndromes of laboratory and farm animals and man will be considered.

ANSC 402 Applied Animal Nutrition (3) Two lectures and one laboratory period per week. Prerequisites: MATH 110, ANSC 401 or permission of instructor. A critical study of those factors which influence the nutritional requirements of ruminants, swine and poultry. Practical feeding methods and procedures used in formulation of economically efficient rations will be presented.

ANSC 403 Applied Animal Nutrition (3) Two lectures and one laboratory period per week. Prerequisites: MATH 110, ANSC 402 or permission of instructor. A critical study of those factors which influence the nutritional requirements of ruminants, swine and poultry. Practical feeding methods and procedures used in formulation of economically efficient rations will be presented.

ANSC 406 Environmental Physiology (3) Prerequisites: Anatomy and physiology. The specific anatomical and physiological modifications employed by animals adapted to certain stressful environments will be considered. Particular emphasis will be placed on the problems of temperature regulation and water balance. Specific areas for consideration will include: animals in cold (including hibernation), animals in dry heat, diving animals and animals in high altitudes.

ANSC 407 Advanced Dairy Production (1) An advanced course primarily designed for teachers of vacational agriculture and county agents. It includes a study of the newer discoveries in dairy cattle nutrition, breeding and management.

ANSC 411 Biology and Management of Shellfish (4) Two lectures and two three-hour laboratory periods each week. Field trips. Identification, biology, management, and culture of commercially-important molluscs and crustacea. Prerequisite: One year of Biology or Zoology. This course will examine the shellfisheries of the world, but will emphasize those of the Northwestern Atlantic Ocean and Chesapeake Bay.

ANSC 412 Introduction to Diseases of Animals (3) Prerequisite: MICB 200 and ZOOL 101. Two lectures and one laboratory period per week. This course gives basic instruction in the nature of disease: including causation, immunity, methods of diagnosis, economic importance, public health aspects and prevention and control of the common diseases of sheep, cattle, swine, horses and poultry.

ANSC 413 Laboratory Animal Management (3) A comprehensive course in care and management of laboratory animals. Emphasis will be placed on physiology, anatomy and special uses for the different species. Disease prevention and regulations for maintaining animal colonies will be covered Field trips will be required.

ANSC 414 Biology and Management of Fish (4) Prerequisite: One year of Biology or Zoology. Two lectures and two three-hour laboratories a week. Fundamentals of individual and population dynamics; theory and practice of sampling fish populations; management schemes.

ANSC 415 Parasitic Diseases of Domestic Animals (3) Prerequisite: ANSC 412 or equivalent. Two lectures and one laboratory per week. A study of parasitic diseases resulting from protozoan and helminth infection and arthropod infestation. Emphasis on parasites of veterinary importance: their identification; life cycles, pathological effects and control by management.

ANSC 416 Wildlife Management (3) Two lectures and one laboratory. An introduction to the interrelationships of game birds and mammals with their environment, population dynamics and the principles of wildlife management.

ANSC 422 Meats (3) Two lectures and one laboratory period per week. Prerequisite: ANSC 221. A course designed to give the basic facts about meat as a food and the factors influencing acceptability, marketing, and quality of fresh meats. It includes comparisons of characteristics of live animals with their carcasses, grading and evaluating carcasses as well as wholesale cuts, and the distribution and merchandising of the nation's meat supply. Laboratory periods are conducted in packing houses, meat distribution centers, retail outlets and university meats laboratory.

ANSC 423 Livestock Management (3) One lecture and two laboratory periods per week. Prerequisite: ANSC 401. Application of various phases of Animal Science to the management and production of beef cattle, sheep and swine.

ANSC 424 Livestock Management (3) One lecture and two laboratory periods per week. Prerequisite: ANSC 423. Applications of various phases of animal science to the management and production of beef cattle, sheep and swine.

ANSC 425 Herpetology (3) Prerequisites: ANSC 211 and ANSC 212; or equivalent. Study of taxonomy, physiology, behavior, functional anatomy, evolution and distribution of present day amphibians and reptiles. Common diseases and management under captive conditions. Identification of poisonous species with appropriate precautions.

ANSC 426 Principles of Breeding (3) Second semester. Three lectures per week. Prerequisites: ANSC 201 or equivalent, ANSC 222, ANSC 423 or 424. Graduate credit (1–3 hours) allowed with permission of instructor. The practical aspects of animal breeding, heredity, variation, selection, development, systems of breeding and pedigree study are considered.

ANSC 432 Horse Farm Management (3) Prerequisite: ANSC 332 and AREC 410. One 90-minute lecture and one four-hour laboratory period per week. A course to develop the technical and managerial skills necessary for the operation of a horse breeding farm. Herd health programs, breeding programs and procedures, foaling activities, foot care, weaning programs, and the maintenance of records incidential to each of these activities.

ANSC 442 Dairy Cattle Breeding (3) Two lectures and one laboratory period per week. Prerequisites: ANSC 242, and ANSC 201. A specialized course in breeding dairy cattle. Emphasis is placed on methods of evaluation and selection, systems of breeding and breeding programs.

ANSC 443 Physiology and Biochemistry of Lactation (3) Prerequisites: ANSC 212 or equivalent and CHEM 261 or CHEM 461. The physiology and biochemistry of milk production in domestic animals, particularly cattle. Mammary gland development and maintenance from the embryo to the fully developed lactating gland. Abnormalities of the mammary gland.

ANSC 444 Analysis of Dairy Production Systems (3) Prerequisites: AGEC 406 and ANSC 203 or 214, or permission of instructor. The business aspects of dairy farming including an evaluation of the costs and returns associated with each segment. The economic impact of pertinent management decisions is studied. Recent developments in animal nutrition and genetics, agricultural economics, agricultural engineering, and agronomic practices are discussed as they apply to management of a dairy herd.

ANSC 446 Physiology of Mammalian Reproduction (3) Prerequisite: ZOOL 422 or ANSC 212. Anatomy and physiology of reproductive processes in domesticated and wild mammals.

ANSC 447 Physiology of Mammalian Reproduction Laboratory (1) Pre-or corequisites: ANSC 446. One three-hour laboratory per week. Animal handling, artificial insemination procedures and analytical techniques useful in Animal Management and reproductive research. Not open to students who have credit for ANSC 446 prior to fall 1976.

ANSC 452 Avian Physiology (2) (Alternate even years) one three-hour laboratory period per week. Prerequisites: A basic course in animal physiology. The basic physiology of the bird is discussed, excluding the reproductive system. Special emphasis is given to physiological differences between birds and other vertebrates.

ANSC 462 Physiology of Hatchability (1) Two lectures and one laboratory period per week. Prerequisite: ZOOL 421 or 422. The physiology of embryonic development as related to principles of hatchability and problems of incubation encountered in the hatchery industry are discussed.

ANSC 463 Nutrition Laboratory (2) Prerequisite: ANSC/NUSC 401 or concurrent registration. Six hours of laboratory per week. Digestibility studies with ruminant and monogastric animals, proximate analysis of various food products, and feeding trials demonstrating classical nutritional deficiencies in laboratory animals.

ANSC 464 Poultry Hygiene (3) Two lectures and one laboratory period per week. Prerequisites: MICB 200 and ANSC 101. Virus, bacterial and protozoan diseases, parasitic diseases, prevention, control and eradication.

ANSC 466 Avian Anatomy (3) Two lectures and one laboratory period per week. Prerequisite: ZOOL 102. Gross and microscopics structure, dissection and demonstration.

ANSC 467 Poultry Breeding and Feeding (1) This course is designed primarily for teachers of vocational agriculture and extension service workers. The first half will be devoted to problems concerning breeding and the development of breeding stock. The second half will be devoted to nutrition.

ANSC 477 Poultry Products and Marketing (1) This course is designed primarily for teachers of vocational agriculture and county agents. It deals with the factors affecting the quality of poultry products and with hatchery management problems, egg and poultry grading, preservation problems and market outlets for Maryland poultry.

ANSC 480 Special Topics in Fish and Wildlife Management (3) Three lectures. Analysis of various state and federal programs related to fish and wildlife management. This would include: fish stocking programs, Maryland deer management program, warm water fish management, acid drainage problems, water quality, water fowl management, wild turkey management and regulations relative to the administration of these programs.

ANSC 487 Special Topics in Animal Science (1) Prerequisite: Permission of instructor. This course is designed primarily for teachers of vocational agriculture and extension service personnel. One primary topic to be selected mutually by the instructor and students will be presented each session.

ANSC 601 Advanced Ruminant Nutrition (2) First semester. One one-hour lecture and one-three hour laboratory per week. Prerequisite: Permission of instructor. Physiological, microbiological and biochemical aspects of the nutrition of ruminants as compared to other animals.

ANSC 603 Mineral Metabolism (3) Second semester. Prerequisites: CHEM 481 and 463. The role of minerals in metabolism of animals and man. Topics to be covered include the role of minerals in energy metabolism, bone structure, electrolyte balance, and as catalysts.

ANSC 604 Vitamin Nutrition (3) Prerequisites: ANSC 401 and CHEM 461. Two one-hour lectures and one two-hour discussion period per week. Advanced study of the fundamental role of vitamins and vitamin-like cofactors in nutrition including chemical properties, absorption, metabolism, excretion and deficiency syndromes. A critical study of the biochemical basis of vitamin function, interrelationship of vitamins with other substances and of certain laboratory techniques.

ANSC 610 Electron Microscopy (4) First and second semesters. Two lectures and two laboratory periods per week. Prerequisites: Permission of instructor. Theory of electron microscopy, electron optics, specimen preparation and techniques, operation of electron photography, interpretation of electron images, related instruments and techniques.

ANSC 612 Energy Nutrition (2) Second semester. Prerequisites: ANSC 402 or NUSC 450, CHEM 461, or consent of instructor. One lecture, one 2 hour laboratory per week. Basic concepts of animal energetics with quantitative descriptions of energy requirements and utilization.

ANSC 614 Proteins (2) Second semester. One lecture and one 2 hour laboratory per week. Prerequisites: ANSC 402 and CHEM 461 or consent of instructor. Advanced study of the roles of amino acids in nutrition and metabolism. Protein digestion, absorption, anabolism, catabolism and amino acid balance.

ANSC 622 Advanced Breeding (2) Second semester, alternate years. Prerequistes: ANSC 426 or equivalent, and biological statistics. This course deals with the more technical phases of heredity and variation, selection indices, breeding systems, and inheritance in farm animals.

ANSC 641 Expermental Mammalian Surgery I (2) First semester. Prerequisite: Permission of instructor. A course presenting the fundamentals of anesthesia and the art of experimental surgery, especially to obtain research preparations.

ANSC 642 Experimental Mammalian Surgery II (3) Second semester. Prerequisites: ANSC 641, permission of instructor. A course emphasizing advanced surgical practices to obtain research preparations, cardiovascular surgery and chronic vascularly isolated organ techniques, experience with pump oxygenator systems, profound hypothermia, hemodialysis, infusion systems, implantation and transplantation procedures are taught.

ANSC 643 Research Methods (3) First semester. One lecture and two laboratory periods per week. Prerequisite: Permission of instructor. The application of biochemical, physio-chemical and statistical methods to problems in biological research.

ANSC 660 Poultry Literature (1–4) First and second semesters. Readings on individual topics are assigned. Written reports required. Methods of analysis and presentation of scientific material are discussed.

ANSC 661 Physiology of Reproduction (3) First semester. Two lectures and one laboratory period a week. Prerequisite: ANSC 212 or its equivalent. The role of the endocrines in reproduction is considered. Fertility, sexual maturity, egg formation, ovulation, and the physiology of oviposition are studied. Comparative processes in birds and mammals are discussed.

ANSC 663 Advanced Nutrition Laboratory (3) Prerequisite; ANSC/NUSC 401; and either CHEM 462 or NUSC 670. One hour of lecture and six hours of laboratory per week. Basic instrumentation and techniques desired for advanced nutritional research. The effect of various nutritional parameters upon intermediary metabolism, enzyme kinetics, endocrinology, and nutrient absorption in laboratory animals.

ANSC 665 Physiological Genetics of Domestic Animals (2) Second semester. Prerequisites: A course in basic genetics and biochemistry. The underlying physiological basis for genetic differences in production traits and selected morphological traits will be discussed. Inheritance of enzymes, protein polymorphisms and physiological traits will be studied.

ANSC 677 Advanced Animal Adaptations to the Environment (2) First semester. Two lectures or discussions per week. Prerequisites: ANSC 406, or permission of instructor. A detailed consideration of certain anatomical and physiological modifications employed by mammals adapted to cold, dry heat or altitude. Each student will submit for discussion a library paper concerning a specific adaptation to an environmental stress.

ANSC 686 Veterinary Bacteriology and Mycology (3) Prerequisite: ANSC 412. The characteristics and role of pathogenic bactena and fungi in diseases of domestic animals with emphasis upon their pathogenic properties, pathogenesis and types of disease, epizootiology, modes of transmission and prophylaxis.

ANSC 687 Veterinary Virology (3) Prerequisite: MICB 460. A detailed study of virus and rickettsial diseases of domestic and laboratory animals. Emphasis on viruses of veterinary importance along with techniques for their propagation, charactenzation and identification.

ANSC 690 Seminar in Population Genetics of Domestic Animals (3) Second semester. Prerequisites: ZOOL 246 and AGRI 401 or their equivalents. Current literature and research dealing with the principles of population genetics as they apply to breeding and selection programs for the genetic improvement of domestic animals, population structure, estimation of genetic parameters, correlated characters, principles and methods of selection, relationship and systems of mating

ANSC 698 Seminar (1) First and second semesters. Students are required to prepare papers based upon current scientific publications relating to animal science, or upon their research work, for presentation before and discussion by the class; (1) recent advances; (2) nutrition; (3) physiology; (4) biochemistry.

ANSC 699 Special Problems in Animal Science (1–2) First and second semesters. Work assigned in proportion to amount of credit. Prerequisite: Approval of staff. Problems will be assigned which relate specifically to the character of work the student is pursuing.

ANSC 799 Master's Thesis Research (1–6)

ANSC 899 Doctoral Dissertation Research (1–8)

Applied Mathematics Program

Professor and Director: Wolfe
(ENAE) *Professors:* Donaldson, Plotkin
Associate Professors: Jones
(BMGT) *Professors:* Bodin, Gass
Associate Professors: Golden, Fromovitz, Widhelm
Assistant Professors: Alt, Assad, Ball
(ENCH) *Professors:* Cadman, Gentry
(ENCE) *Professor:* Sternberg
Associate Professor: Garber
(CMSC) *Professors:* Edmundson, Kanal, Minker, Stewart
Associate Professors: Agrawala, Basili
Assistant Professor: O'Leary
(ECON) *Professors:* Almon, Kelejian
Associate Professor: Betancourt
(ENEE) *Professors:* DeClaris, Davisson, Harger, Newcomb, Taylor
Associate Professors: Baras, Blankenship, Ephremides, Tretter
(MATH) *Professors:* Antman, Douglis, Hummel, Osborn, Pearl, Wolfe
Associate Professors: Berenstein, Cooper, Fitzpatrick, Johnson, Liu, Sather, Schneider
Assistant Professor: Arnold
(ENME) *Professors:* Cunniff, Marks, Yang
Associate Professors: Walston
(METO) *Professor:* Baer
Associate Professors: Rodenhuis, Vernekar
Assistant Professor: Robock
(IPST) *Research Professors:* Babuska, Dorfman, Faller, Hubbard, Kellogg, Lashinsky, Olver, Yorke, Zwanzig
Associate Professor: Johnson
(PHYS) *Professors:* Banerjee, Brill, Dragt, Ferrell, Glasser, Glick, Greenberg, Griffin, MacDonald, Misner, Prange, Sucher, Woo
Associate Professors: Fivel, Kim, Korenman
(STAT) *Professors:* Mikulski, Yang
Associate Professor: Smith
Assistant Professors: Kedem, Slud

The Interdisciplinary Applied Mathematics Program offers the degrees of Master of Arts and Doctor of Philosophy. These are awarded for graduate study and research in mathematics and its applications in the engineering, physical, and social sciences. In addition, the Applied Mathematics Program offers certified minors in applied mathematics for graduate students not enrolled in the Program.

The Program is administratively affiliated with the Department of Mathematics. In particular, under this arrangement the Department of Mathematics assumes the responsibility for the administration of the applied mathematics courses under the MAPL label. Moreover, the Graduate Office of the Department maintains the records of all students in the Applied Mathematics Program and handles correspondence with those applying for admission. However, it is important that any application for admission indicates clearly whether a student wishes to enter the Mathematics (MATH) or the Applied Mathematics (MAPL) Program.

The faculty considers the primary aim of applied mathematics to be the understanding of a wide spectrum of scientific phenomena through the use of mathematical ideas, methods, and techniques. The applied mathematician should be both a mathematical specialist and a versatile scientist, whose interests and motivations derive from a strong desire to confront highly complex or descriptive situations with mathematical analysis and ideas. In line

with this, at least half of the required work is expected to be in courses with primarily mathematical content, and the remaining part has to include a coherent set of courses in some field of application outside of the usual mathematics curriculum. Some of the areas currently pursued by graduate students in the Program are various areas of physics, information structures, meteorology, operations research, pattern recognition, structural mechanics, and systems and control theory. Many other areas of study are available through the participating departments. It may also be noted that the faculty includes a strong group in numerical analysis and that many students include courses on numerical and scientific computing in their programs.

Admission and Degree Information

In addition to the general requirements of the Graduate School, applicants for admission to graduate study in the Program should have completed, with at least a B average (3.0 on a 4.0 scale), an undergraduate program of study which includes a strong emphasis on mathematics. The student's general ability for graduate study in the Program and mathematical capabilities will be determined from his or her record or by special examination.

A mathematical preparation with grades of B or better at least through the level of advanced calculus in a school of good academic standing will normally be considered sufficient demonstration of the required mathematical background. Previous education in some part of an applicant's area, such as physics, one of the engineering disciplines, economics, etc., and a basic competence in computational techniques will be favorably considered in a student's application for admission to the Program, although this is not a prerequisite.

When a student has decided upon an area of specialization, a study advisory committee is appointed by the Director of the Program. This committee, working together with the student, is responsible for formulating a course of study leading toward the degree sought. This course of study must constitute a unified, coherent program in an acceptable field of specialization of applied mathematics and must meet with the approval of the Graduate Committee for Applied Mathematics.

Besides any other requirements specified by the Graduate School, the following specific conditions must be met for an M.A. degree in Applied Mathematics:

(1) At least 12 of the 24 required course credits for the M.A. degree with thesis are in courses with primarily mathematical content. At least 6 of these 12 credits are on the 600–800 level. At least 3 of the 12 credits are in a course on numerical analysis. At least 1 of the 12 credits is in an approved applied mathematics seminar.

(2) The 24 required course credits include either 6 credits at the 600–800 level, or alternatively, 9 credits of which 3 are at the 600–800 level, in courses whose content is primarily in the student's chosen field(s) of application.

No course may be used to meet the requirements under both (1) and (2) above.

(1) At least 15 of the 30 required course credits for the non-thesis master's option are in courses with primarily mathematical content. At least 9 of these 15 credits are on a 600–800 level. At least 3 of these 15 credits are in a course on numerical analysis. At least 1 of the 15 credits is an approved applied mathematics seminar.

(2) The 30 required course credits include either 6 credits at the 600–800 level, or, alternately, 9 credits of which 3 are at the 600–800 level, in courses whose content is primarily in the student's chosen field(s) of application.

No course may be used to meet the requirements under both (1) and (2) above.

The student must pass the comprehensive examination for the M.A. degree with thesis. The examination consists of at least three parts, with at least one of the parts in a mathematics area, and at least one of the parts in an area of application. The parts shall be taken as closely together as possible.

The student in the doctoral program must take a minimum of 36 hours of courses exclusive of dissertation research. At least 24 of these 36 credits are at the 600–800 level.

A transfer of at most 27 credits of graduate-level work taken at a regionally accredited institution prior to or after admission to the Ph.D. Program is permitted providing the (1) the Graduate Committee for Applied Mathematics has approved the transfer; (2) a grade of B or better was earned in the courses taken (no course with pass/fail grades will be accepted); (3) the credit was earned within the time limit imposed for completing the Ph.D. degree at the University of Maryland.

Course Distribution: 1) at least 18 of the required 36 credits are in courses with primarily mathematical content. At least 9 of these 18 credits are on the 600–800 level. At least 3 of the 18 credits are in numerical analysis. At least 2 of the 18 credits are in approved mathematics seminars. 2) The 36 credits include either 6 credits at the 600–800 level or alternately 9 credits of which 3 are at the 600–800 level in courses whose content is primarily in the student's chosen field(s) of application. 3) No course may be used to meet the requirements under both items (1) and (2) above.

The student must pass the comprehensive Examination for the Ph.D. The examination consists of at least three parts, with at least one of the parts in an area of mathematics, and at least one of the parts in an area of application. The parts shall be taken as closely together as possible.

In addition the student must pass the Candidacy Examination for the Ph.D. degree. The Candidacy Examination is an oral examination which serves as a test of the detailed preparation of a student in the area of specialization and seeks to discover if he or she has a deep enough understanding to carry out the proposed research. The examination assumes further advanced course work beyond the Comprehensive Examination.

Certified Minors

The Applied Mathematics Program offers certified minors in applied mathematics to regular graduate students who are enrolled in a graduate degree program of the University of Maryland other than the Program itself. The successful completion of the requirements for such a minor will be recorded in the student's transcripts. Moreover, a number of departments participating in the Applied Mathematics Program permit the requirements for the certified minor to replace part of the degree requirements of the major department.

A student wishing to pursue a certified minor in applied mathematics must fill out an application form for participation in the Certified Minor Program. Such forms are available from the office of the Director of the Applied Mathematics Program.

The Certified Minor Program at the Master's level must contain at least either 6 semester hours in 400-level courses and 3 semester hours in 600-level courses, or 6 semester hours in 600-level courses. At the doctoral level the Certified Minor Program must contain at least 9 semester hours of graduate credit, of which at most 3 hours may be on the 400-level.

Courses

MAPL 460 Computational Methods (3) Prerequisites: MATH 240, 241, and CMSC 110, or equivalent. Basic computational methods for interpolation, least squares, approximation, numerical quadrature, numerical solution of polynomial and transcendental equations, systems of linear equations and initial value problems for ordinary differential equations. Emphasis on the methods and their computational properties rather than on their analytic aspects. (Listed also as CMSC 460.)

MAPL 470 Numerical Mathematics: Analysis (3) Prerequisites: MATH 240 and 241; CMSC 110 or equivalent. This course, with MAPL/CMSC 471, forms a one-year introduction to numerical analysis at the advanced undergraduate level. Interpolation, numerical differentiation and integration, solution of nonlinear equations, acceleration of convergence, numerical treatment of differential equations. Topics will be supplemented with programming assignments. (Listed also CMSC 470.)

MAPL 471 Numerical Mathematics: Linear Algebra (3) Prerequisites: MATH 240 and MATH 241; CMSC 110 or equivalent. The course, with MAPL/CMSC 470, forms a one-year introduction to numerical analysis at the advanced undergraduate level. Direct solution of linear systems, norms, least squares problems, the symmetric eigenvalue problem, basic iterative methods. Topics will be supplemented with programming assignments. (Listed also as CMSC 471.)

MAPL 477 Optimization (3) Prerequisite: CMSC 110 and MATH 405 or MATH 474. Linear programming including the simplex algorithm and dual linear programs, convex sets and elements of convex programming, combinatorial optimization integer programming. (Listed also as CMSC 477.)

MAPL 498 Selected Topics in Applied Mathematics (1–3) Prerequisite: Permission of the instructor. Topics in applied mathematics of special interest to advanced undergraduate students. May be repeated to a maximum of six credits if the subject matter is different.

MAPL 600 Advanced Linear Numerical Analysis (3) Prerequisites: MAPL 470, 471 and MATH 405 or MATH 474; or consent of instructor. Advanced topics in numerical linear algebra, such as dense eigenvalue problems, sparse elimination, iterative methods, and other topics. (Same as CMSC 770.)

MAPL 604 Numerical Solution of Nonlinear Equations (3) Prerequisites: MAPL 470, 471 and MATH 410; or consent of instructor. Numerical solution of nonlinear equations in one and several variables. Existence questions. Minimization methods. Selected applications. (Same as CMSC 772.)

MAPL 607 Advanced Numerical Optimization (3) Prerequisites: MATH 410 and MAPL/CMSC 477; or equivalent. Modern numerical methods for solving unconstrained and constrained nonlinear optimization problems in finite dimensions. Design of computational algorithms and on the analysis of their properties.

MAPL 610 Numerical Solution of Ordinary Differential Equations (3) Prerequisites: MAPL/CMSC 470 and MATH 414, or consent of instructor. Methods for solving initial value problems in ordinary differential equations. Single step and multi-step methods, stability and convergence, adaptive methods. Shooting methods for boundary value problems.

MAPL 612 Numerical Methods in Partial Differential Equations (3) Prerequisites: Concurrent registration in MATH/MAPL 680 or in MAPL 650; or consent of the instructor. Introduction to problems and methodologies of the solution of partial differential equations. Finite difference methods for elliptic, parabolic, and hyperbolic equations, first order systems, and eigenvalue problems. Variational formulation of elliptic problems. The finite element method and its relation to finite difference methods.

MAPL 614 Mathematics of the Finite Element Method (3) Prerequisites: Concurrent registration in MATH/MAPL 681 or in MATH/MAPL 685; or MAPL 612 and consent of instructor. Variational formulations

of linear and nonlinear elliptic boundary value problems; formulation of the finite element method, construction of finite element subspaces; error estimates; eigenvalue problems; time dependent problems.

MAPL 640 System Theory (3) General system models. State variables and state spaces. Differential dynamical systems. Discrete time systems. Lineanty and its implications. Controllability and observability. State space structure and representation. Realization theory and algorithmic solutions. Parameterizations of linear systems; canonical forms. Basic results from stability theory. Stabilizability. Fine structure of linear multivariable systems; minimal indices and polynomial matrices. Inverse nyquist array. Geometric methods in design. Interplay between frequency domain and state space design methods. Interactive computer-aided design methods. (Listed also as ENEE 663)

MAPL 641 Optimal Control (3) Prerequisite: ENEE 460 or consent of the instructor. General optimization and control problems. Static optimization problems. Linear and nonlinear programming methods. Geometric interpretations. Dynamic optimization problems. Discrete time maximum principle and applications. Pontryagin maximum principle in continuous time. Dynamic-programming. Feedback realization of solutions. Extensive applications to problems in optimal design, navigation and guidance, power systems. Introduction to state constrained and singular optimal control problems. (Listed also as ENEE 664.)

MAPL 644 Estimation and Detection Theory (3) Prerequisite: ENEE 620 or equivalent or consent of instructor. Estimation of unknown parameters, Cramer-Rao lower bound: optimum (map) demodulation: filtering, amplitude and angle modulation, comparison with conventional systems; statistical decision theory; Bayes, Minimax, Neyman/Pearson, Criteria-68 simple and composite hypotheses; application to coherent and incoherent signal detection; M-Ary hypotheses; application to uncoded and coded digital communication systems. (Listed also as ENEE 621.)

MAPL 650 Advanced Mathematics for the Physical Sciences I (3) Prerequisites: MATH 240 and 410. Effective analytic methods for the study of linear and nonlinear equations that arise in the physical sciences; algebraic equations, integral equations and ordinary differential equations. (Not open to graduate students in MATH or MAPL without special permission from their advisor.)

MAPL 651 Advanced Mathematics for the Physical Sciences II (3) Prerequisite: MAPL 650. Continuation of MAPL 650. Partial differential equations; linear and nonlinear eigenvalue problems. (Not open to graduate students in MATH or MAPL without special permission from their advisor.)

MAPL 655 Asymptotic Analysis and Special Functions I (3) Prerequisite: MATH 413 or MATH 463. Transcendental equations, gamma function, orthogonal polynomials, Bessel functions, integral transforms, Watson's lemma, LaPlace's method, stationary phase, analytic theory of ordinary differential equations, Liouville-Green (or WKBJ) approximation. (Cross-listed with MATH 655)

MAPL 656 Asymptotic Analysis and Special Functions II (3) Prerequisite: MATH/MAPL 655. Steepest descents, coalescing saddle-points, singular integral equations, irregular singularities, Bessel, hypergeometric, and Legendre functions, Euler-MacLaurin formula, Darboux's method, turning points, phase shift. (Cross-listed with MATH 656)

MAPL 670 Ordinary Differential Equations I (3) Prerequisites: MATH 405 and 410 or the equivalent. Existence and uniqueness, linear systems usually with Floquet theory for periodic systems, linearization and stability, planar systems usually with Poincare-Bendixson theorem. (Same as MATH 670)

MAPL 671 Ordinary Differential Equations II (3) Prerequisites: MATH 630 and MATH/MAPL 670 or equivalent. The content of this course varies with the interests of the instructor and the class. Stability theory, control, time delay systems, Hamiltonian systems, bifurcation theory, and boundary value problems. (Same as MATH 671)

MAPL 673 Classical Methods in Partial Differential Equations I (3) Prerequisite: MATH 410 or equivalent. Cauchy problem for the wave equation and heat equation, Dirichlet and Neumann problem for Laplace's equation. Classification of equations, Cauchy-Kowaleski theorem. General second order linear and nonlinear elliptic and parabolic equations. (Same as MATH 673.)

MAPL 674 Classical Methods in Partial Differential Equations II (3) Prerequisite: MATH/MAPL 673. General theory of first order partial differential equations, characteristics, complete integrals, Hamilton-Jacobi theory. Hyperbolic systems in two independent variables, existence and uniqueness, shock waves, applications to compressible flow (Same as MATH 674.)

MAPL 680 Eigenvalue and Boundary Value Problems I (3) Prerequisite: MATH 405 and 410 or equivalent. Operational methods applied to ordinary differential equations. Introduction to linear spaces, compact operators in Hilbert space, study of Eigenvalues (Same as MATH 680.)

MAPL 681 Eigenvalue and Boundary Value Problems II (3) Prerequisite: MATH/MAPL 680. Boundary value problems for linear differential equations. Method of energy integrals applied to Laplace's equation, heat equation and the wave equation. Study of Eigenvalues. (Same as MATH 681.)

MAPL 685 Modern Methods in Partial Differential Equations I (3) Prerequisite: MATH 630 and 631. Spaces of distributions, Fourier transforms, concept of weak and strong solutions. Existence, uniqueness and regularity theory for elliptic and parabolic problems using methods of functional analysis. (Same as MATH 685.)

MAPL 686 Modern Methods in Partial Differential Equations II (3) Prerequisite: MATH/MAPL 685. Emphasis on nonlinear problems. Sobolev embedding theorems, methods of monotonicity, compactness, applications to elliptic, parabolic and hyperbolic problems. (Same as MATH 686.)

MAPL 698 Advanced Topics in Applied Mathematics (1–4) Prerequisite: Consent of instructor. Repeatable if topic differs.

MAPL 699 Applied Mathematics Seminar (1–3) Prerequisite: Consent of instructor. Seminar to acquaint students with a variety of applications of mathematics and to develop skills in presentation techniques. Repeatable if topic differs.

MAPL 701 Introduction to Continuum Mechanics (3) Prerequisite: Consent of instructor. Background from algebra and geometry, kinematics of deformation. Stress equations of motion, thermodynamics of deforming continua. Theory of constitutive relations. Materials with memory. Initial boundary value problems of nonlinear solid and fluid thermomechanics. Boundary value problems of linear theories of solids and fluids.

MAPL 710 Linear Elasticity (3) Prerequisite: MAPL 701 or consent of instructor. Formulation of the equations. Compatability, uniquess, existence, representation and qualitative behavior of solutions. Variational principles. St. Venant beam problems, plane strain and plane stress, half-space problems, contact problems, vibration problems, wave propagation. Emphasis is placed on formulation and technique rather than on specific examples.

MAPL 711 Non-Linear Elasticity (3) Prerequisite: MAPL 701, or consent of instructor. Formulation of initial boundary value problems. Constitutive restrictions. Special solutions. Perturbation methods and their validity. Theories of rods and shells. Buckling and stability Shock propagation.

MAPL 720 Fluid Dynamics I (3) Prerequisite: Consent of instructor. A mathematical formulation and treatment of problems arising in the theory of incompressible, compressible and viscous fluids

MAPL 721 Fluid Dynamics II (3) Prerequisite: Consent of instructor. A continuation of MAPL 720.

MAPL 731 Information Theory (3) Corequisite: ENEE 620. Prerequisite: STAT 400 or equivalent. Information measure, entrophy, mutual information, source encoding, noiseless coding theorem; noisy coding theorem; exponential error bounds; introduction to probalistic error correcting codes, block and convolutional codes and error bounds; channels with memory; continuous channels; rate distortion function. (Same as ENEE 721.)

MAPL 732 Error Correcting Codes (3) Introduction to linear codes; bounds on the error correction capabilities of codes; convolutional codes with threshold, sequential and Viterbi decoding, cyclic random error correcting codes; P-N sequences, cyclic and convolutional burst error correcting codes (Listed also as ENEE 722.)

MAPL 735 Advanced Methods and Algorithms in Detection and Filtering (3) Prerequisite: ENEE 621 Foundations of random processes. Conditional expectations. Markov processes and martingales. ITO calculus. Detection and estimation of continuous signals with continuous observations. Jump processes. Detection and estimation with discontinuous observations Discrete-time case. Fast algorithms for digital filtering problems. (Listed also as ENEE 772.)

MAPL 740 Mathematical Methods in Control Engineering (3) Prerequisite: ENEE 663 or consent of instructor. Applications of compactness in control and communication, geometric methods in optimal control of lumped and distributed systems and harmonic analysis of linear systems. Applications to control and estimation problems. (Listed also as ENEE 760.)

MAPL 741 Control of Distributed Parameter Systems (3) Prerequisite: An introductory course in functional analytic methods at the level of ENEE 760, and background in control and system theory Study of systems governed by partial differential equations. Delay systems. Boundary and distributed control, Lyapunov stability. Optimal control of systems governed by partial differential equations and of delay systems. Applications to continuum mechanics, distributed networks, biology, economics, and engineering. (Same as ENEE 761.)

MAPL 742 Stochastic Control (3) Prerequisite: ENEE 620 or equivalent; and ENEE 663/MAPL 640; or consent of the instructor. Stochastic control systems, numerical methods for the Ricatti equation, the separation principle, control of linear systems with Gaussian signals and quadratic cost, non-linear stochastic control, stochastic stability, introduction to stochastic games. (Same as ENEE 762.)

MAPL 799 Master's Thesis Research (1–6)

MAPL 899 Doctoral Dissertation Research (1–8)

Architecture Program

Professor and Dean: Hill
Assistant Dean: Fogle
Assistant to the Dean: Ratcliff
Professors: Hill, Schlesinger, Loss
Associate Professors: Bechhoefer, Bennett, Fogle, Lewis, Lord, Senkevitch
Assistant Professors: Cass, Constant, Dean, DuPuy, Johns, Miner, Muse, Stup , Vann
Visiting Professors: Peterson, Stanton
Lecturers: Arikoglu, Axtell, Bullock, Flynn, Kramer, Li, Percival, Rounds, Simmons, Wilkes

The School of Architecture offers a graduate program leading to the professional degree, Master of Architecture. The School's basic objective is to provide the highest possible quality professional education and training in architecture. Its program is organized around required courses in architectural and urban design, architectural history and theory and architectural science and technology. Electives in Architecture and related fields are available in a curriculum that is rigorous and challenging.
The School is accredited by the National Architectural Accreditation Board. It is a member of the Association of Collegiate Schools of Architecture assigned to the Northeastern Region.

Admission and Degree Information

Admission to the graduate program is competitive. Candidates must satisfy the general requirements of the Graduate School and submit the following: 1) three letters of recommendation from persons competent to judge the

applicant's probable success in graduate architectural school; 2) results of the Graduate Record Examination aptitude and advanced tests (not over five years old); and 3) evidence of creative ability in the form of a portfolio of drawings, photographs, or other expressive media; details concerning format and content may be obtained from the School of Architecture.

Applications will be considered from three categories of students: 1) students with four-year baccalaureate degrees (architecture or equivalent major) from accredited architecture schools; 2) students with baccalaureate degrees *not in architecture* from an accredited college or university who successfully complete specified undergraduate prerequisites which are outlined by the School of Architecture; and 3) students with an accredited professional degree *in architecture*, Bachelor or Master of Architecture. Students are expected to enroll on a full-time basis. For complete information on curricula requirements for these categories, write to the School of Architecture.

1) Students entering the program with a four-year baccalaureate degree in architecture from an accredited college or university normally require two years of graduate study to complete the requirements for the professional degree, Master of Architecture. The established curriculum requires four semesters of academic work emcompassing a total of 60 credits. Additional credits may be required depending upon the admissions committee's evaluation of the individual's academic and architectural experience.

2) Students entering the professional program with other than architecture undergraduate majors will normally require three years (including summer work) to complete all requirements for the Master of Architecture, including prerequisites. Students in this category will be admitted as undergraduate special students. They are expected to make up the specific coursework, or its equivalent, required for the Bachelor of Science with a major in architecture, before being admitted to graduate status. Although these students will not automatically be candidates for, nor receive, the B.S. degree, they could, at their option, qualify for and receive the B.S. degree if they meet all applicable University and School of Architecture requirements. Information on required courses and curriculum may be obtained from the School of Architecture.

3) A special one-year option leading to the Master of Architecture degree is available to those students already possessing a professional degree in architecture (B. Arch. or M. Arch.) from an accredited program. This option is designed to accommodate the needs of students who wish to do advanced, highly-specialized work beyond that required for the professional degree. Applicants must specify in detail the nature of the proposed course of study, for reviewal and approval by the admissions committee prior to their admission. They must complete a total of 30 credits, including ARCH 799 Thesis in Architecture (6 credits). At least 12 credits, other than thesis, shall be 600–level or above. All course selections must be approved by the graduate committee of the School.

Presently, areas of concentration in which the School has noteworthy resources for advanced work are architectural and urban design, architectural history and preservation, and architectural technology.

Facilities and Special Resources

The School of Architecture of the University of Maryland is ideally located between Washington, D.C. and Baltimore, in the midst of a large number of historical communities and a varied physical environment. The resulting opportunity for environmental design study is unsurpassed. Resources of the School include a modern physical plant designed for environmental design education; extensive on-site libraries of books, current periodicals and slides; a faculty whose credentials encompass expertise in design, architectural structures, solar and conventional heating and cooling system design, energy optimization, architectural history and preservation, urban planning, landscape architecture and other environmental design specialities. The School also provides graduate students an opportunity for professional experience and service through its nonprofit Center for Architectural Design and Research, CADRE Corporation, housed in the School, whose mission is to broaden the educational experience of students through environmental design services directed by faculty members, rendered to a variety of clients. A limited number of stipends for graduate students are normally available through participation in CADRE Corporation projects.

Financial Assistance

The School of Architecture offers a limited and varying number of teaching and research assistantships, scholarships, fellowships and internships. Applicants should apply for financial assistance when submitting the application for admission.

Courses

ARCH 400 Architecture Studio III (4) Prerequisites—ARCH 301 with a grade of C or better, and ARCH 311. Corequisite—ARCH 410, except by permission of the dean. Continuation of design studio, with emphasis on comprehensive building design and introduction to urban design factors. Lecture and studio 9 hours per week.

ARCH 401 Architecture Studio IV (4) Prerequisite—ARCH 400 with a grade of C or better and ARCH 410. corequisite—ARCH 411, except by permission of the dean. Continuation of design studio with emphasis on urban design factors. Lecture and studio, 9 hours per week.

ARCH 402 Architecture Studio III (6) Prerequisite: ARCH 303 with a grade of C or better. Design projects involving the elements of environmental control, basic structural systems, building processes and materials. Three hours of lecture and six hours of studio per week.

ARCH 403 Architecture Studio IV (6) Prequisite: ARCH 402 with a grade of C or better. Design projects involving forms generated by different structural systems. environmental controls and methods of construction. Three hours

ARCH 412 Architectural Structures II (3) Prerequisite: ARCH 312. Principles and applications in analysis and design of determinate structures: design of timber and steel structures; principles of masonry design.

ARCH 413 Structural Systems in Architecture (3) Theory and application of selected complex structural systems as they relate to architectural decisions. Prerequisite, ARCH 410 or by permission of the instructor. Seminar, 3 hours per week.

ARCH 414 Solar Energy Applications for Buildings (3) Prerequisite: ARCH 313 or permission of instructor. Methods of utilizing solar energy to provide heating, cooling, hot water, and electricity for buildings and related techniques for reducing energy consumption.

ARCH 415 Environmental Control Systems II (3) Prerequisite: ARCH 313. Theory and practice of managing energy, water and waste in buildings.

ARCH 416 Architectural Structures III (3) Prequisite: arch 412. Introduction to indeterminate structures. Principles and applications in the design of reinforced concrete structures; introduction to wind and seismic loads; foundation systems.

ARCH 417 Environmental Control Systems III (3) Prerequisite: ARCH 415. Design principles and practical applications of lighting and acoustics, with emphasis on the integration of environmental and structural systems; vertical transportation; fire protection.

ARCH 418 Selected Topics in Architectural Science (1–4) Prerequisite: Consent of instructor. Repeatable to a maximum of 7 credits, provided content is different.

ARCH 419 Independent Studies in Architectural Science (1–4) Proposed work must have a faculty sponsor and receive approval of the curriculum committee. Repeatable to a maximum of 7 credits.

ARCH 420 History of American Architecture (3) Prequisite: ARCH 221 or permission of instructor. American architecture from the late 17th to the 20th century.

ARCH 421 Seminar in the History of American Architecture (3) Prerequisite: ARCH 420 or permission of instructor. Advanced investigation of historical problems in American architecture.

ARCH 422 French Architecture 1750–1800 (3) French architectural theory and practice of the second half of the eighteenth century. A reading knowledge of French will be required. Colloquium and independent research. By permission of the instructor.

ARCH 424 History of Russian Architecture (3) Prerequisite: ARCH 221, or permission of instructor. Major trends in Russian architecture in the medieval (10th—17th centuries), imperial (1703—1917), and soviet periods.

ARCH 427 Theories of Architecture (3) Prerequisite: ARCH 221, or permission of instructor. Selected historical and modern theories of architectural design. For architecture majors only.

ARCH 428 Selected Topics in Architectural History (1–3) Prerequisite: Consent of instructor. Repeatable to a maximum of 7 credits, provided the content is different. 50ARCH 429 **Independent Studies in Architectural History (1–4)** Proposed work must have a faculty sponsor and receive approval of the curriculum committee. Repeatable to a maximum of 6 credits.

ARCH 431 History of Ancient Architecture (3) Prerequisite: ARCH 221, or permission of instructor. Architecture of the ancient world through the Roman period, with emphasis on classical Greece and Rome.

ARCH 432 History of Medieval Architecture (3) Prerequisite: ARCH 221, or permission of instructor. Architecture of Western Europe from the early Christian and Byzantine periods through the late gothic, with consideration of parallel developments in the eastern world.

ARCH 433 History of Renaissance Architecture (3) Prerequisite: ARCH 221, or permission of instructor. Renaisssance architectural principles and trends in the 15th and 16th centuries and their modifications in the Baroque period.

ARCH 434 History of Modern Architecture (3) Prerequisite: ARCH 221, or permission of instructor. Architectural trends and principles from 1750 to the present, with emphasis on developments since the mid-19th century.

ARCH 435 Seminar in the History of Modern Architecture (3) Prerequisite: ARCH 434 or permission of instructor. Advanced investigation of historical problems in modern architecture.

ARCH 442 Studies in Visual Design (3) Prerequisite: ARCH 303. Studio work in visual design independent of architectural problem solving.

ARCH 443 The Photography of Architecture (3) One and one-half hours lecture and four hours laboratory per week. Prerequisite: ARCH 344. Examination of the meaning of documentation and the use of photography in the evaluation of architecture. Architecture students only, except by permission of the instructor.

ARCH 447 Advanced Seminar in Photography (3) Prerequisites: ARCH 340 or APDS 337 or JOUR 351; and consent of instructor. Advanced study of photographic criticism through empirical methods, for students proficient in photographic skills. Photographic assignments, laboratory, seminar, 3 hours per week.

ARCH 448 Selected Topics in Visual Studies (1–4) Prerequisite. Consent of instructor. Repeatable to a maximum of 7 credits, provided the content is different.

ARCH 449 Independent Studies in Visual Studies (1–4) Proposed work must have a faculty sponsor and

receive approval of the curriculum committee. Repeatable to a maximum of 6 credits.

ARCH 450 Introduction to Urban Planning (3) Introduction to city planning theory, methodology and techniques, dealing with normative, urban, structural, economic, social aspects of the city; urban planning as a process. Architectural majors or by permission of the instructor. Lecture, seminar, 3 hours per week.

ARCH 451 Urban Design Seminar (3) Prerequisite: ARCH 350 or permission of the instructor. Advanced investigation into problems of analysis and evaluation of the design of urban areas, spaces and complexes with emphasis on physical and social considerations, effects of public policies, through case studies. Field observations.

ARCH 453 Urban Problems Seminar (3) Prerequisite: Permission of instructor. A case study of urban development issues, dealing primarily with socio-economic aspects of changes in the built environment.

ARCH 454 Theories of Urban Form (3) Theories of planning and design of urban spaces, building complexes, and new communities.

ARCH 458 Selected Topics in Urban Planning (1–4) Prerequisite: Consent of instructor. Repeatable to a maximum of 7 credits, provided the content is different.

ARCH 459 Independent Studies in Urban Planning (1–4) Proposed work must have a faculty sponsor and receive approval of the curriculum committee. Repeatable to a maximum of 6 credits.

ARCH 460 Site Analysis and Design (3) Principles and methods of site analysis; the influence of natural and man-made site factors on site design and architectural form. For architecture majors only, or by permission of instructor.

ARCH 470 Computer Applications in Architecture (3) Prerequisite: ARCH 302 or permission of instructor. Introduction to computer programming and utilization, with emphasis on architectural applications.

ARCH 472 Economic Determinants in Architecture (3) Introduction to economic factors influencing architectural form and design, including land economics, real estate, financing, project development, financial planning, construction and cost control.

ARCH 478 Selected Topics in Architecture (1–4) Prerequisite: Consent of instructor. Repeatable to a maximum of 7 credits, provided the content is different.

ARCH 479 Independent Studies in Architecture (1–4) Proposed work must have a faculty sponsor and receive approval of the curriculum committee. Repeatable to a maximum of 6 credits.

ARCH 480 Problems and Methods of Architectural Preservation (3) Prerequisite: ARCH 420 or permission of instructor. Theory and practice of preservation in America, with emphasis on the problems and techniques of community preservation.

ARCH 488 Selected Topics in Architectural Preservation (1–4) Prerequisite: Consent of instructor. Repeatable to a maximum of seven credits, provided the content is different.

ARCH 489 Independent Studies in Architectural Preservation (1–4) Proposed work must have a faculty sponsor and receive approval of the curriculum committee. Repeatable to a maximum of 6 credits.

ARCH 600 Architecture Studio V (6) Prerequisite: ARCH 403, or equivalent. Comprehensive building and urban design; studio options in advanced topical problems. Three hours of lecture and six hours of studio per week.

ARCH 601 Architecture Studio VI (6) Prerequisite: ARCH 600. Continuation of arch 600. Three hours of lecture and six hours of studio per week.

ARCH 612 Advanced Structural Analysis in Architecture (3) Prerequisite: ARCH 416. Qualitative and quantitative analysis and design of selected complex structural systems.

ARCH 613 Structural Systems in Architecture (3) Prerequisite: ARCH 416 or permission of instructor. Theory and application of selected complex structural systems as they relate to architectural decisions.

ARCH 614 Environmental Systems in Architecture (3) Prerequisite: ARCH 415 and 417 or permission of instructor. Qualitative analysis of selected environmental systems and design determinants.

ARCH 678 Selected Topics in Architecture (1–6) Prerequisite: Permission of instructor. Repeatable to a maximum of six credits provided the subject matter is different.

ARCH 679 Independent Studies in Architecture (1–6) Prerequisite: Consent of instructor. Repeatable to a maximum of six credits.

ARCH 700 Architecture Studio VII (6) Prerequisite: ARCH 601. Continuation of ARCH 601. Three hours of lecture and six hours of studio per week.

ARCH 770 Professional Practice (3) Prerequisite: ARCH 601. Project management, organizational, legal, economic and ethical aspects of architecture.

ARCH 797 Thesis Proseminar (3) Prerequisite: ARCH 601. Directed research and preparation of thesis program.

ARCH 798 Thesis in Architecture (1–6) Prerequisites: ARCH 700 and 797.

ARCH 799 Master's Thesis Research (1–6)

Art Program

Professor and Chairman: Driskell
Professors: Campbell, deLeiris, Denny, Levitine, Lynch, Morrison, Pemberton, Rearick
Associate Professors: DiFederico, Farquhar, Forbes, Gelman, Johns, Klank, Lapinski, Niese, Spiro, Truitt, Withers
Assistant Professors: DeMonte, Ferraioli, Hauptman, Krushenick, Patton, Puryear, Reid, Spaulding, Weigl, Wheelock, Willis

The Department of Art offers programs of graduate study leading to the degrees of Master of Arts in art history, Master of Fine Arts in studio art and Doctor of Philosophy in art history. Both disciplines, rooted in the concept of art as a humanistic experience, share an essential common aim: the development of the student's aesthetic sensitivity, understanding and knowledge. The major in art history is committed to the advanced study and scholarly interpretation of existing works of art, from the prehistoric era to the present, while the studio major stresses the student's direct participation in the creation of works of art.

Admission and Degree Information

For admission to graduate study in studio art, an undergraduate degree with an art major from an accredited college or university, or its equivalent, is required. The candidate should have approximately 30 credit hours of undergraduate work in studio courses and 12 credit hours in art history courses. Other humanities area courses should be part of the candidate's undergraduate preparation. In addition, special departmental requirements must be met. A candidate for the Master of Fine Arts degree will be required to pass an oral comprehensive examination, present an exhibition of his thesis work, write an abstract based on the thesis, and present an oral defense of the thesis.

For admission to graduate study in art history, in addition to the approved undergraduate degree, or its equivalent, special departmental requirements must be met. Departmental requirements for the Master of Arts degree in Art History include ARTH 692; reading knowledge of French or German (evidenced by an examination administered by the Art Department); a written comprehensive examination which tests the candidate's knowledge and comprehension of principal areas and phases of art history; a thesis which demonstrates competency in research and in original investigation by the candidate; and a final oral examination on the thesis and the field which it represents.

Requirements for the Doctor of Philosophy degree in Art History include ARTH 692; reading knowledge of French and German; an oral examination and a written examination; a dissertation which demonstrates the candidate's capacity to perform independent research in the field of art history; and a final oral examination on the dissertation and the field it represents.

Applicants are encouraged to submit their applications by early March for entrance in the Fall and by early October for entrance in Spring as the available spaces are usually filled early.

Facilities and Special Resources

The Middle Atlantic Symposium in the History of Art is an annual Spring event which is sponsored by the University of Maryland and held jointly at the National Gallery of Art and the University. This symposium provides the opportunity for advanced graduate students from the member institutions to present their research in professional form. From time to time the Department of Art also publishes abstracts of the Symposium papers in *Studies in Art History presented at the Middle Atlantic Symposium in the History of Art.*

In the summer of 1979, the University of Maryland Caesarea Project will begin excavations at Caesarea Maritima, Israel. Qualified graduate students are eligible for participation in the excavations, and work at this site may lead to M.A. or Ph.D. dissertation subjects.

The University of Maryland is thirty-five minutes from the National Gallery, the National Collection of Fine Arts and Portrait Gallery, the Freer Gallery, the Corcoran Gallery, the Phillips Gallery, Dumbarton Oaks, the Hirshhorn Collection. In Baltimore, forty-five minutes from the University, is the Museum of Art and the Walters Gallery.

Financial Assistance

A limited number of graduate assistantships are available in art.

Additional Information

Description of Departmental requirements for the above programs and other information may be obtained from the Department of Art.

For information on work leading to the degree of Master of Education in art education, the student is referred to the section devoted to Secondary Education in this catalog.

Courses

Art Education

ARTE 600 Advanced Problems in Art Education (3)

ARTE 601 Advanced Problems in Art Education (3)

ARTE 799 Master's Thesis Research (1–6)

ART HISTORY

ARTH 401 Greek and Roman Painting (3) Survey of Greek and Roman frescoes and panels; study of extant paintings and lost works known only through literary sources.

ARTH 402 Greek Art and Archaeology (3) Greek art and archaeology from 1000 B.C. to 50 B.C.

ARTH 403 Roman Art and Archaeology (3) Roman art and archaeology from Etruscan origins to Diocletian.

ARTH 404 Bronze Age Art (3) Art of the Near East, Egypt and Aegean.

ARTH 405 Japanese Painting (3) Survey of Japanese painting from the sixth through the sixteenth centuries.

including traditional Buddhist paintings, narrative scrolls, and Zen-related ink painting.

ARTH 406 Arts of the East I (3) The arts of Japan and China from prehistory to 1400.

ARTH 407 Arts of the East II (3) The arts of Japan and China from the 1400's to the present.

ARTH 410 Early Christian—Early Byzantine Art (3) Sculpture, painting, architecture, and the minor arts from about 312 to 726 A.D.

ARTH 411 Byzantine Art, 726–1453 (3) Sculpture, painting, architecture and the minor arts from 726 to 1453 A.D.

ARTH 412 Medieval Art (3) Architecture, sculpute and painting in the Middle Ages. First semester will stress romanesque.

ARTH 413 Medieval Art (3) Architecture, sculpture and painting in the Middle Ages. Second semester will stress the Gothic period.

ARTH 416 Northern European Painting in the 15th Century (3) Painting in the Netherlands, France and Germany.

ARTH 417 Northern European Painting in the 16th Century (3) Painting in the Netherlands, France and Germany.

ARTH 422 Early Renaissance Art in Italy (3) Architecture, sculpture and painting from about 1400 to 1430.

ARTH 423 Early Renaissance Art in Italy (3) Architecture, sculpture and painting from about 1430 to 1475.

ARTH 424 High Renaissance Art in Italy (3) Architecture, sculpture and painting from about 1475 to 1500.

ARTH 425 High Renaissance Art in Italy (3) Architecture, sculpture and painting from about 1500 to 1525.

ARTH 430 European Baroque Art (3) Architecture, sculpture and painting of the major southern European centers in the 17th century.

ARTH 431 European Baroque Art (3) Architecture, sculpture and painting of the major northern European centers in the 17th century.

ARTH 434 French Painting (3) French painting from 1400 to 1600. From Fouquet to Poussin.

ARTH 435 French Painting (3) French painting from 1600 to 1800. From Le Brun to David.

ARTH 440 19th Century European Art (3) Architecture, sculpture and painting in Europe from neo-classicism to romanticism.

ARTH 441 19th Century European Art (3) Architecture, sculpture and painting in Europe. From realism, to impressionism and symbolism.

ARTH 445 Impressionism and Neo-Impressionism (3) Prerequisite: ARTH 260, 261 or consent of instructor. History of impressionism and neo-impressionism: artists, styles, art theories, criticism, sources and influence on 20th century.

ARTH 450 20th Century Art (3) Painting, sculpture and architecture from the late 19th century to 1920.

ARTH 451 20th Century Art (3) Painting, sculpture and architecture from 1920 to the present.

ARTH 452 History of Photography (3) History of photography as art from 1839 to the present.

ARTH 454 Nineteenth and Twentieth Century Sculpture (3) Trends in sculpture from neo-classicism to the present. Emphasis will be put on the redefinition of sculpture during the 20th century.

ARTH 460 History of the Graphic Arts (3) Prerequisite: ARTH 100, or ARTH 260 and 261, or consent of instructor. Graphic techniques and styles in Europe from 1400 to 1800; contributions of major artists.

ARTH 462 African Art (3) First semester, the cultures west of the Niger River (Nigeria through Mali) from 400 B.C. to the present. The art is studied through its iconography and function in the culture and the intercultural influences upon the artists, including a study of the societies, cults and cermonies during which the art was used.

ARTH 463 African Art (3) Second semester, the cultures east and south of Nigeria. The art is studied through its iconography and function in the culture and the intercultural influences upon the artists, including a study of the societies, cults and cermonies during which the art was used

ARTH 464 African Art Research (3) Seminar with concentration on particular aspects of African art. The course is given at the Museum of African Art in Washington, D. C.

ARTH 470 Latin American Art (3) Art of the prehispanic and the colonial periods.

ARTH 471 Latin American Art (3) Art of the 19th and 20th centuries.

ARTH 473 Arts of Black Americans I (3) The visual arts of Black Americans from the colonial period through the 19th century, including crafts and decorative arts.

ARTH 474 Arts of Black Americans II (3) The visual arts of Black Americans in the 20th century, including crafts and decorative arts.

ARTH 476 History of American Art to 1900. (3) Architecture, sculpture and painting in the United States from the colonial period to 1900.

ARTH 477 History of American Art since 1900 (3) Architecture, sculpture and painting in the United States from 1900 to the present.

ARTH 489 Special Topics in Art History (3) May be repeated to a maximum of six credits. Prerequisite: Consent of department head or instructor.

ARTH 498 Directed Studies in Art History I (2–3) For advanced students, by permission of department chairman. Course may be repeated for credit if content differs.

ARTH 499 Directed Studies In Art History II (2–3

ARTH 612 Romanesque Art (3) Painting and sculpture in Western Europe in the 11th and 12th centuries; regional styles; relationships between styles of painting and sculpture; religious content.

ARTH 614 Gothic Art (3) Painting and sculpture in Western Europe in the 11th and 12th centuries; regional styles; relationships between styles of painting and sculpture; religious content.

ARTH 630 The Art of Mannerism (3) Prerequisite: ART 423 or permission of instructor. Mannerism in Europe during the 16th century; beginnings in Italy; ramifications in France, Germany, Flanders, Spain; painting, architecture, and sculpture.

ARTH 634 French Painting from Lebrun to Gericault—1715–1815 (3) Development of iconography and style from the Baroque to neo-classicism and romanticism. Trends and major artists.

ARTH 656 19th Century Realism, 1830–1860 (3) Courbet and the problem of realism; precursors, David, Gericault, landscape schools; Manet; artistic and social theories; realism outside France. Prerequisite: ART 440 or 441 or equivalent.

ARTH 662 20th Century European Art (3) Prerequisite: ART 450, 451 or equivalent. A detailed examination of the art of a individual country in the 12th century: France, Germany, Italy, Spain, England.

ARTH 676 20th Century American Art (3) Prerequisite: ART 450, 451 or equivalent. The 'Eight,' the Armory Show, American abstraction, romantic-realism, new deal art projects, American surrealism and expressionism.

ARTH 692 Methods of Art History (3) Methods of research and criticism applied to typical art-historical problems; bibliography and other research tools. May be taken for credit one or two semesters.

ARTH 694 Museum Training Program (3)

ARTH 695 Museum Training Program (3)

ARTH 698 Directed Graduate Studies in Art History (3) For advanced graduate students, by permission of head of department. Course may be repeated for credit if content differs.

ARTH 699 Special Topics in Art History (3) Prerequisite: Consent of department head or instructor.

ARTH 702 Seminar in Classical Art (3) Prerequisite: ARTH 402, 403 or permission of instructor.

ARTH 708 Seminar in Japanese Painting (3) Prerequisite: ARTH 406 or 407 or permission of instructor. Japanese painting of the 14th through 16th centuries, and their origins in chinese models. Course may be repeated for a maximum of 6 credits if the content differs.

ARTH 709 Seminar in Early Christian and Byzantine Art (3) Prerequisite: ARTH 410 or 411 or permission of instructor. Course may be repeated for a maximum of six credits if the content differs.

ARTH 712 Seminar in Medieval Art (3) Prerequisite: ARTH 412, 413 or permission of instructor.

ARTH 728 Seminar Topics in Italian Renaissance Art (3) Problems selected from significant themes in the field of Italian Renaissance art and architecture, 1200–1600. May be repeated for credit if content differs.

ARTH 736 Seminar in 18th Century European Art (3)

ARTH 740 Seminar (3) Problems derived from the development of romantic art during the 18th and 19th centuries.

ARTH 743 Seminar in 19th Century European Art (3) Problems derived from the period starting with David and ending with Cezanne.

ARTH 760 Seminar in Contemporary Art (3)

ARTH 770 Seminar in Latin-American Art (3) Prerequisite: ARTH 471 or permission of instructor.

ARTH 772 Seminar in Modern Mexican Art (3) Prerequisite: ARTH 471 or permission of instructor. Problems of Mexican art of the 19th and 20th centuries; Mexicanismo; the 'mural renaissance'; architectural regionalism.

ARTH 774 Seminar in 19th Century American Art (3) Problems in architecture and painting from the end of the colonial period until 1860.

ARTH 780 Seminar—Problems in Architectural History and Criticism (3)

ARTH 784 Seminar in Literary Sources of Art History (3) Art historical sources from Pliny to Malraux.

ARTH 798 Directed Graduate Studies In Art History (3)

ARTH 799 Master's Thesis Research (1–6)

ARTH 899 Doctoral Dissertation Research (1–8)

Art Studio ARTS 404 Experiments in Visual Processes (3) Six hours per week. Prerequisites: Either arts 220, 330 or 340. Investigation and execution of process oriented art. Group and individual experimental projects.

ARTS 410 Drawing IV (3) Six hours per week. Prerequisite: ARTS 310. Advanced drawing, with emphasis on human figure, its structure and organic likeness to forms in nature. Compositional problems deriving from this relationship are also stressed.

ARTS 420 Painting IV (3) Six hours per week. Prerequisite: ARTS 324. Creative painting. Emphasis on personal direction and self-criticism. Group seminars.

ARTS 430 Sculpture IV (3) Six hours per week. Prerequisite: ARTS 335. Problems and techniques of newer concepts, utilizing various materials, such as plastics and metals. Technical aspects of welding stressed.

ARTS 440 Printmaking III (3) Six hours per week. Prerequisite: ARTS 340 and 344. Contemporary experimental techniques of one print medium with group discussions.

ARTS 441 Printmaking IV (3) Six hours per week. Prerequisite: ARTS 440. Continuation of arts 440.

ARTS 489 Special Problems in Studio Arts (3) For advanced students, by permission of department chairman. Course may be repeated for credit if content differs.

ARTS 610 Drawing (3) Sustained treatment of a theme chosen by student. Wide variety of media.

ARTS 614 Drawing (3) Traditional materials and methods including Oriental, Sumi ink drawing and techniques of classical European masters.

ARTS 616 Drawing (3) Detailed anatomical study of the human figure and preparation of large scale mural compositions.

ARTS 620 Painting (3)

ARTS 624 Painting (3)

ARTS 626 Painting (3)

ARTS 627 Painting (3)

ARTS 630 Experimentation in Sculpture (3)

ARTS 634 Experimentation in Sculpture (3)

ARTS 636 Materials and Techniques in Sculpture (3) For advanced students, methods of armature building, and the use of a variety of stone, wood, metal, and plastic materials.

ARTS 637 Sculpture-Casting and Foundry (3) The traditional methods of plaster casting and the complicated types involving metal, cire perdue, sand-casting and newer methods, such as cold metal process.

ARTS 640 Printmaking (3) Advanced problems. Relief process.

ARTS 644 Printmaking (3) Advanced problems. Intaglio process.

ARTS 646 Printmaking (3) Advanced problems. Lithographic process.

ARTS 647 Seminar in Printmaking (3)

ARTS 689 Special Problems in Studio Art (3) Prerequisite: Consent of instructor. Repeatable to a maximum of six hours.

ARTS 690 Drawing and Painting (3) Preparation and execution of a wall decoration.

ARTS 698 Directed Graduate Studies in Studio Art (3) For advanced graduate students by permission of head of department. Course may be repeated for credit if content differs.

ARTS 798 Directed Graduate Studies in Studio Art (3)

ARTS 799 Master's Thesis Research (1–6)

Astronomy Program

Professor and Acting Director: Kundu
Professors: Bell, Erickson, Kerr, Opik (part-time), Rose, Smith, Wentzel, Zuckerman
Adjunct Professors: Brandt
Associate Professors: A'Hearn, Harrington, Matthews, Trimble (part-time), Zipoy
Adjunct Associate Professor: Clark
Assistant Professors: Eichler, Scott, Wilson

The Astronomy Program, administratively part of the Department of Physics and Astronomy, offers programs of study leading to the degrees of M.S. and Ph.D. in Astronomy. The M.S. program includes both thesis and non-thesis options. Areas of specialization include: galactic structure, interstellar medium, extragalactic astronomy, stellar atmospheres, stellar evolution, solar physics, solar system, astronomical instrumentation, and cometary studies.

A full schedule of courses in all fields of astronomy is offered including galactic astronomy, astrophysics, solar system astronomy, observational astronomy, celestial mechanics, solar physics, study of the interstellar medium and extragalactic astronomy. The faculty has expertise in most major branches of astronomy. The research program is centered around several major areas of interest. One is high energy and plasma astrophysics with particular interest centering on applications to the study of extragalactic radio sources and of solar phenomena. There are related observational programs in the areas of solar radio astronomy and of extragalactic astronomy. Other areas include galactic structure, the interstellar medium with particular emphases on molecules in space and on star formation, stellar atmospheres and cometary physics.

Admission and Degree Information

No formal undergraduate course work in astronomy is required. However, an entering student should have a working knowledge of the basic facts of astronomy such as is obtainable from one of the many elementary textbooks. A more advanced knowledge of astronomy will of course enable a student to progress more rapidly during the first year of graduate work.

Normally a satisfactory score on the GRE Advanced Test in Physics is required before an applicant's admission to the Graduate School will be considered. In special cases, the Graduate Entrance Committee may waive this requirement, and set other conditions as a requirement for admission, to be fulfilled either before admission or during the first year at Maryland.

Qualification for the Ph.D. program (which is decided in the middle or at the end of the second year) requires a written examination on basic astronomy at the end of the first year and an extensive research project during the second year. Overall performance in the exam, course work and research determines admission to the Ph.D. program.

All students must demonstrate competence both in theoretical astrophysics and in radio and optical observing techniques. The former can normally be satisfied by taking ASTR 650, 651 and the latter by taking ASTR 411. All students must take at least two credits of ASTR 698. No other Astronomy courses are specifically required, but candidates for the Ph.D. should expect to take a number of courses at the 600 level according to their interests. Twelve credits of advanced physics courses are required for the Ph.D.

Candidates for the Master of Science Degree with thesis are required to obtain 24 credits (exclusive of registration for masters research) of which at least 12 are in the major area and at least 12 must be at the 600 level (not necessarily the same 12). In addition, at least 6 credits must be in a related field (supporting area).

To obtain the Master of Science Degree without a thesis, 6 credits in the major at the 600 level are required in addition to the general requirements described above. That is, a total of 30 credits are required, of which 18 must be in the major, and at least 18 at the 600 level. The student must also pass a written examination, usually consisting of the written part of the Ph.D. Qualifying Examination with appropriately chosen passing requirements.

Facilities and Special Resources

The Astronomy Program carries on an extensive research program in the areas discussed above with the graduate students playing an active role in this research. Approximately one-fourth of all research papers published have a graduate student as one of the authors. The Program maintains a small optical observatory on campus. Due to the site, its main use is to enable students to gain experience in observational techniques and to test out new equipment. There is an important effort in the program devoted to the development of optical instrumentation. A Fourier Transform Spectrometer is now essentially operational and a photoelectric Fabry Perot Interferometer is being developed.

The Program also operates a radio observatory near Borrego Springs, California. This is designed to operate at meter wavelengths and is one of the major long wavelength observatories in the country. A major commitment of this observatory will be to solar research, with the immediate aim of developing a radio heliograph which can provide real time mapping of the radio sun. Work will also go on there in the areas of galactic and extragalactic radio astronomy.

The library facilities of the Program have recently benefited from the acquisition of a major new collection. Reorganization of the current facilities is in process. When completed, the Astronomy library should be one of the foremost collections in the country.

The Program has strong interaction with the national astronomy observatories, and many of the students and faculty carry on observing programs at them. There are also very close ties with neighboring scientific institutes. A major program of cooperative research has been established with the Goddard Space Flight Center and a number of graduate students carry on research programs there. There are also close contacts with the Naval Observatory, the Naval Research Labs and other government institutes.

Financial Assistance

Essentially all eligible graduate students are funded. The program offers both Research and Teaching Assistantships.

Additional Information

For more information, especially for physics courses related to astronomy, see the section on Physics. A brochure entitled "Graduate Study in Astronomy," describing the requirements, the courses and the research program in detail, is available from the department. All correspondence, including that concerning admission to the Astronomy Program, should be addressed to:

Astronomy Program
University of Maryland

Courses

ASTR 400 Stellar Astrophysics (3) Pre- or corequisite: PHYS 422 or consent of instructor. Stellar atmospheres, stellar structure and evolution, neutron stars and black holes.

ASTR 401 Interstellar and Extragalactic Astrophysics (3) Pre- or corequisite: PHYS 422 or consent of instructor. A survey of the physics of the interstellar medium and of astrophysics as it relates to galaxies and cosmology.

ASTR 410 Observational Astronomy (3) Prerequisites: Working knowledge of calculus, physics through PHYS 284, or 263, and 3 credits of Astronomy. An introduction to current methods of obtaining astronomical information including radio, infrared, optical, ultraviolet, and X-ray astronomy. The laboratory work will involve photographic and photoelectric observations with the department's optical telescope and 21-cm line spectroscopy, flux measurements and interferometry with the department's radiotelescopes.

ASTR 411 Observational Astronomy (3) Prerequisites: ASTR 410, working knowledge of calculus, physics through PHYS 284, or 263, and 3 credits of Astronomy. An introduction to current methods of obtaining astronomical information including radio, infrared, optical, ultra-violet, and X-ray astronomy. The laboratory work will involve photographic and photoelectric observations with the department's optical telescope and 21-cm line spectroscopy, flux measurements and interferometry with the department's radiotelescopes. Observatory work on individual projects. Every semester.

ASTR 420 Introduction to Galactic Research (3) Prerequisite: PHYS 192 and ASTR 182 or equivalent, or consent of instructor. Methods of galactic research, stellar motions, clusters of stars, evolution of the galaxy, study of our own and nearby galaxies.

ASTR 430 The Solar System (3) Prerequisite: MATH 246 and either PHYS 263 or PHYS 294, or consent of instructor. The structure of planetary atmospheres, radiative transfer in planetary atmospheres, remote sensing of planetary surfaces, interior structure of

planets. Structure of comets. Brief discussions of asteroids, satellite systems, and solar system evolution.

ASTR 440 Introduction to Extra-Galactic Astronomy (3) Prerequisite: PHYS 192 and ASTR 182 or equivalent, or consent of instructor. Properties of normal and peculiar galaxies, including radio galaxies and quasars; expansion of the universe and cosmology.

ASTR 450 Celestial Mechanics (3) Prerequisite: PHYS 410 or consent of instructor. Celestial mechanics, orbit theory, equations of motion.

ASTR 498 Special Problems in Astronomy (1–6) Prerequisite: Major in physics or astronomy and/or consent of advisor. Research or special study. Credit according to work done.

ASTR 600 Stellar Atmospheres (3) Prerequisite: ASTR 650 or an equivalent brief introduction to stellar atmospheres, or consent of instructor. Observational methods, line formation, curve of growth, equation of transfer, stars with large envelopes, variable stars, novae, magnetic fields in stars.

ASTR 605 Stellar Interiors (3) Prerequisite: ASTR 651 or an equivalent brief introduction to stellar interiors, or consent of instructor. A study of stellar structure and evolution: energy transfer and generation in the interior of a star, the structure of stars including problems of turbulence, determination of chemical composition, non-homogeneous stars, pulsating stars, novae, evolution of both young and old stars, the final stages of stellar evolution.

ASTR 620 Galactic Research (3) Prerequisites: Astronomy 420, 410, 411, or consent of the instructor. Current methods of research into galactic structure, kinematics, and dynamics. Basic dynamical theory. Optical and radio observational methods and current results. Review of presently-determined distribution and kinematics of the major constituents of the galaxy. Evolution of the galaxy.

ASTR 625 Dynamics of Stellar Systems (3) Prerequisite: PHYS 601 or ASTR 420. Study of the structure and evolution of dynamical systems encountered in astronomy. Stellar encounters viewed as a two-body problem, statistical treatment of encounters, study of dynamical problems in connection with star clusters, ellipsoidal galaxies, nuclei of galaxies, high-velocity stars.

ASTR 630 Physics of the Solar System (3) Prerequisite: PHYS 422. A survey of the problems of interplanetary space, the solar wind, comets and meteors, planetary structure and atmospheres, motions of particles in the earth's magnetic field.

ASTR 650 Survey of Astrophysics I (3) Prerequisite: PHYS 411 and 422 or their equivalents, or consent of instructor. The first semester survey of the theoretical tools of astrophysics. Gas and magnetohydrodynamics applied to interstellar and solar phenomena. Radiation of high-energy particles. Introduction to stellar atmospheres.

ASTR 651 Survey of Astrophysics II (3) Prerequisite: ASTR 650 or consent of instructor. Brief survey of stellar structure and evolution, and the physics of the interstellar medium and the solar atmosphere.

ASTR 660 Solar Physics (3) Prerequisites: PHYS 422, ASTR 400 or consent of instructor. A detailed study of solar atmosphere. Physics of solar phenomena, such as solar flares, structure of the corona, etc.

ASTR 670 Interstellar Matter (3) Prerequisite: ASTR 651 or an equivalent brief introduction to interstellar matter, or consent of instructor. A study of the physical properties of interstellar gas and dust: regions of ionized hydrogen, regions of neutral hydrogen, the problems of interstellar dust and molecules.

ASTR 688 Special Topics in Modern Astronomy (1–3) Prerequisite: Consent of instructor. Special topics such as extragalactic radio sources, plasma astrophysics, the H.R. diagram, chemistry of the interstellar medium, radiophysics of the sun.

ASTR 698 Seminar (1) Seminars on various topics in advanced astronomy are held each semester, with the contents varied each year. One credit for each semester. There are weekly colloquia by staff, astronomers from the Washington area, and visiting astronomers, usually on topics related to their own work.

ASTR 699 Special Problems in Advanced Astronomy (1–6)

ASTR 788 Selected Topics in Modern Astronomy (1–3)

ASTR 799 Master's Thesis Research (1–6)

ASTR 899 Doctoral Dissertation Research (1–8)

Biochemistry Program

Professor and Director: Keeney
Professors: Goldsby, Holmlund, Keeney, Ponnamperuma
Associate Professors: Campagnoni, Hansen, Lakshmanan, Sampugna
Assistant Professor: Dunaway-Mariano

The Graduate Program in Biochemistry is the College Park component of the University of Maryland Graduate Program in Biochemistry which also has components at University of Maryland Baltimore County and at the University of Maryland Medical School and Dental School in Baltimore. The program offers study leading to Master of Science and Doctor of Philosophy degrees. Research specialization at College Park is available in analytical biochemistry, developmental biochemistry, drug metabolism, enzyme kinetics, immunochemistry, lipid biochemistry, marine biochemistry, membrane structure and function, metabolic regulation, neuro-chemistry, nucleic acid biochemistry, and nutritional biochemistry.

Admission and Degree Information

Both the thesis and non-thesis options are offered for the M.S. degree. Applicants should have completed an undergraduate program of study with strong emphasis on chemistry and/or biology with appropriate supporting courses in mathematics and physics. Before obtaining a degree in the program, a student must demonstrate adequate preparation in biochemistry, and in analytical, organic and physical chemistry. For this purpose diagnostic examinations in these subjects are offered to students at the beginning of their first semester. Students who perform unsatisfactorily on these examinations or who may not have had undergraduate preparation in one or more of these areas, will be advised to register for appropriate courses. Information on course work, comprehensive examinations and the research interests of the faculty is available for the guidance of degree candidates.

Facilities and Special Resources

Biochemistry research is conducted in a new building occupied in 1975. In addition to well-equipped research laboratories, the following central facilities are available: animal colony, fermentation pilot plant, electron microscope, analytical ultracentrifuge, PDP–11 computer, liquid scintillation counters, nuclear magnetic resonance spectrometers, and a chemistry-biochemistry library.

Financial Assistance

Graduate teaching assistantships are usually available in the Chemistry Department. The assistantships involve teaching undergraduate laboratory and recitation classes and permit tuition waiver for a ten-credit program of graduate study each semester.

Additional Information

Information on requirements and research interests of the faculty may be obtained from the Director of the Program, Dr. Mark Keeney.

Courses

BCHM 461 Biochemistry I (3) Prerequisite: CHEM 203–204 or 213–214, or permission of instructor. A comprehensive introduction to general biochemistry. The chemistry and metabolism of carbohydrates, lipids, nucleic acids, and proteins.

BCHM 462 Biochemistry II (3) Prerequisite: BCHM 461. **A continuation of BCHM 461.**

BCHM 463 Biochemistry Laboratory I (2) Two three-hour laboratory periods per week. Pre- or corerequisite: BCHM 461.

BCHM 464 Biochemistry Laboratory II (2) Two three-hour laboratory periods per week. Prerequisite: BCHM 462 or current registration therein, and CHEM 430 or BCHM 463.

BCHM 661 Proteins, Amino Acids, and Carbohydrates (2) Prerequisite: BCHM 462 or equivalent.

BCHM 662 Biological Energy Transductions, Vitamins, and Hormones (2) Prerequisite: BCHM 462 or equivalent.

BCHM 663 Enzymes (2) Prerequisite: BCHM 462 or equivalent.

BCHM 665 Biochemistry of Lipids (2) Prerequisite: BCHM 462 or equivalent. Classification and chemistry of lipids, lipogenesis and energy metabolism of lipids, structural lipids, and endocrine control of lipid metabolism in mammals.

BCHM 666 Biophysical Chemistry (2) Prerequisite: BCHM 461 and CHEM 482, or consent of instructor.

BCHM 668 Special Problems in Biochemistry (2–4) Two to four three-hour laboratory periods per week. Prerequisite: BCHM 464 or equivalent.

BCHM 669 Special Topics in Biochemistry (2) Prerequisite: BCHM 462 or equivalent.

BCHM 699 Special Problems in Biochemistry (1–6) Prerequisite: One semester of graduate study in Biochemistry. Laboratory experience in a research environment. Restricted to students in the non-thesis M.S. option. Repeatable for a maximum of 6 credits.

BCHM 799 Master's Thesis Research (1–6)

BCHM 898 Seminar (1)

BCHM 899 Doctoral Dissertation Research (1–8)

Botany Program

Professor and Chairman: Patterson
Professors: Bean, Corbett, Galloway, Kantzes, Klarman, Krusberg, Lockard[1], Sisler
Associate Professors: Barnett, Bottino, Karlander, Motta, Reveal.
Assistant Professors: Barrett, Cooke, Racusen, Rissler, Teramura, Van Valkenburg, Vigil.

[1]Joint appointment with Secondary Education

The Department of Botany offers graduate programs leading to the degrees of Master of Science and Doctor of Philosophy. Courses and research problems are developed on a personal basis and arranged according to the intellectual and professional needs of the student. Course programs are flexible and are designed under close supervision by the student's advisor. The objective of the program is to equip the student with a background and techniques for a career in plant science in academic, governmental, industrial or private laboratories.

The areas of specialization are anatomy and morphology, plant biochemistry, cell biology, plant ecology, physiology of fungi, genetics and molecular biology, marine botany, mycology, plant nematology, plant pathology, phycology, plant physiology, taxonomy, and virology.

Admission and Degree Information

There are no special admission requirements. A high degree of intellectual excellence is of

greater consequence than completion of a particular curriculum at the undergraduate level. The degree requirements are flexible. However, they involve demonstration of competence in the broad field of botany, as well as completion of courses in other disciplines which are supportive of modern competence in this field. A foreign language may be required if deemed essential by the student's Graduate Advisory Committee.

Facilities and Special Resources

The Department has laboratories equipped to investigate most phases of botanical and molecular biological research. Field and greenhouse facilities are available for research requiring plant culture. Major pieces of equipment include a transmission electron microscope, ultracentrifuges, X-ray equipment, low-speed centrifuges, microtomes, for cutting ultrathin sections, infra-red spectrophotometer, recording spectrophotometers, gas chromatographs, environmental controlled growth chambers. Herbarium, departmental reference room, enzyme preparation rooms, dark rooms, cold rooms, special culture apparatus for algae, fungi, and higher plants, spectrophotometers, and respirometers are among the many special pieces of equipment and facilities that are available for research.

Financial Assistance

Financial assistance is available in the form of teaching and research assistantships.

Additional Information

The Department has a special brochure available upon request. For specific information on departmental programs, admission procedures or financial aid, contact:

Chairman, Department of Botany
University of Maryland

Courses

BOTN 401 Origins of Modern Botany (1) Prerequisite: 20 credit hours in biological sciences including BOTN 100 or 101 or equivalent. History of Botany as a science, from Ancient Greece through the 18th century; emphasis on botany as an intellectual and cultural pursuit.

BOTN 402 Plant Microtechnique (3) Prerequisite: BOTN 100 or 101, and consent of instructor. One lecture and five hours of laboratory per week. Preparation of temporary and permanent mounts, including selection of material, killing and fixing, embedding, sectioning, and staining methods.

BOTN 403 Medicinal and Poisonous Plants (2) Prerequiste: BOTN 100 or 101 and CHEM 104. A study of plants important to man that have medicinal or poisonous properties. Emphasis on plant source, plant description, the active agent and its beneficial or detrimental physiological action and effects.

BOTN 405 Advanced Plant Taxonomy (3) Two lectures and one laboratory period per week. Prerequisites: BOTN 202 and BOTN 212, or equivalents. A review of the history and principles of plant taxonomy with emphasis on monographic and floristic research. A detailed laboratory review of the families of flowering plants.

BOTN 407 Teaching Methods in Botany (2) Four two-hour laboratory demonstration periods per week, for eight weeks. Prerequisite: BOTN 100 or equivalent. A study of the biological principles of common plants, and demonstrations, projects, and visual aids suitable for teaching in primary and secondary schools.

BOTN 413 Plant Geography (2) Prerequisite: BOTN 100 or equivalent. A study of plant distribution throughout the world and the factors generally associated with such distribution.

BOTN 414 Plant Genetics (3) Prerequisite: BOTN 100 or equivalent. The basic principles of plant genetics are presented, the mechanics of transmission of the hereditary factors in relation to the life cycle of seed plants, the genetics of specialized organs and tissues, spontaneous and induced mutations of basic and economic significance gene action, genetic maps, the fundamentals of polyploidy, and genetics in relation to methods of plant breeding are the topics considered

BOTN 415 Plants and Mankind (2) Prerequisite: BOTN 100 or equivalent. A survey of the plants which are utilized by man, the diversity of such utilization, and their historic and economic significance.

BOTN 416 Principles of Plant Anatomy (4) Two lectures and two 2-hour laboratory periods per week. The origin and development of cells, tissues, and tissue systems of vascular plants with special emphasis on seed-bearing plants. Particular stress is given to the comparative, systematic, and evolutionary study of the structural components of the plants. Prerequisite: General Botany.

BOTN 417 Field Botany and Taxonomy (2) Prerequisite: BOTN 100 or General Biology. Four two-hour laboratory periods a week for eight weeks. The identification of trees, shrubs, and herbs, emphasizing the native plants of Maryland. Manuals, keys, and other techniques will be used. Numerous short field trips will be taken. Each student will make an individual collection.

BOTN 419 Natural History of Tropical Plants (2) Prerequisite: One course in plant taxonomy or permission of instructor. An introduction to tropical vascular plants with emphasis on their morphological, anatomical, and habital peculiarities and major taxonomic features, geographic distribution and economic utilization of selected families. Two, one-hour lectures per week.

BOTN 420 Plant Cytology (4) Two lectures and two laboratory periods per week. An introductory course in the methods and techniques of cell biology as they apply to the organization, functions and structure of plants at the cellular and subcellular level. Botany 101 or its equivalent, one year of college chemistry and one year of college physics.

BOTN 424 Diagnosis and Control of Plant Diseases (3) Prerequisite: BOTN 221. Two lectures and one laboratory period per week. A study of the diagnosis and control of plant diseases. Emphasis on recognizing the symptoms of plant disease and control of the causal organisms. Field trips and a collection of diseased plant specimens.

BOTN 425 Diseases of Ornamentals and Turf (2) Prerequisite: BOTN 221. Designed for those students who need practical experience in recognition and control of ornamentals and turf diseases. The symptoms and current control measures for diseases in these crop areas will be discussed.

BOTN 426 Mycology (4) Two lectures and two three—hour laboratory periods per week. Prerequisite: Botany 101 or permission of the instructor. An introductory course in the biology, morphology and taxonomy of the fungi.

BOTN 427 Field Plant Pathology (1) Prerequisite: BOTN 221, or equivalent. Summer session: Lecture and laboratory to be arranged. The techniques of pesticide evaluation and the identification and control of diseases of Maryland crops are discussed. Offered in alternate years or more frequently with demand.

BOTN 441 Plant Physiology (4) Prerequisites: BOTN 100 and general chemistry. Two lectures and one four-hour laboratory period a week. Organic chemistry strongly recommended. A survey of the general physiological activities of plants.

BOTN 462 Plant Ecology (2) Prerequisite: BOTN 100. The dynamics of populations as affected by environmental factors with special emphasis on the structure and composition of natural plant communities, both terrestial and aquatic.

BOTN 463 Ecology of Marsh and Dune Vegetation (2) Prerequisites: BOTN 100. An examination of the biology of higher plants in dune and marsh ecosystems.

BOTN 464 Plant Ecology Laboratory (2) Prerequisite: BOTN 462 or its equivalent or concurrent enrollment therein. One three-hour laboratory period a week. Two or three field trips per semester. The application of field and experimental methods to the qualitative and quantitative study of vegetation and ecosystems.

BOTN 471 Marine and Estuarine Botany (3) Prerequisite: BOTN 441 or equivalent. An ecological discussion of plant life in the marine environment of sea coasts, salt marshes, estuaries and open seas.

BOTN 475 General Phycology (4) Prerequisites: BOTN 100 and BOTN 202, or permission of instructor. One lecture and two three-hour laboratory periods per week. An introductory study of both macro- and microalgae, including the taxonomy, morphology, and life cycles of both fresh water and marine forms.

BOTN 612 Vascular Plant Morphology (3) Two lectures and one laboratory period per week. Prerequisites: BOTN 202, BOTN 212, and BOTN 416, or equivalents. A comparative study of the morphology of vascular plants, with special emphasis on the evolution and morphogenesis of plant organs.

BOTN 613 Identification of Wood and Timbers (2) Prerequisites: BOTN 416 or equivalent and permission of instructor. Methods and procedures for determination of native and exotic woods used in commerce. Use of keys to and descriptions of timbers, ongins of indigenous and imported woods, vernacular and trade names, properties, uses, and associated literature.

BOTN 615 Plant Cytogenetics (3) First semester. Two lectures and one laboratory period a week. Prerequisite: Introductory genetics. An advanced study of the current status of plant genetics, particularly gene mutations and their relation to chromosome changes in corn and other favorable materials.

BOTN 620 Methods in Plant Tissue Culture (2) Prerequisite: Consent of instructor. One lecture and one two-hour laboratory period a week. A methodology and techniques course designed to give the student background and experience in plant tissue culture.

BOTN 621 Physiology of Fungi (2) First semester. Prerequisites: Organic chemistry and BOTN 441 or equivalent in bacterial or animal physiology. A study of various aspects of fungal metabolism, nutrition, biochemical transformation, fungal products, and mechanism of fungicidal action.

BOTN 623 Physiology of Fungi Laboratory (1) First semester. One laboratory period per week. Prerequisites: BOTN 621 or concurrent registration therein. Application of equipment and techniques in the study of fungal physiology.

BOTN 632 Plant Virology (2) Second semester. Two lectures per week on the biological, biochemical, and biophysical aspects of viruses and virus diseases of plants. Prerequisites: Bachelor's degree or equivalent in any biological science and permission of instructor.

BOTN 634 Plant Virology Laboratory (2) Second semester. Two laboratories per week on the application and techniques for studying the biological, biochemical and biophysical aspects of plant viruses. Prerequisites: Bachelor's degree or equivalent in any biological science and BOTN 632 or concurrent registration therein, and permission of the instructor.

BOTN 636 Plant Nematology (4) Second semester. Two lectures and two laboratory periods a week. Prerequisite: BOTN 221 or permission of instructor. (Not offered 1970–71). The study of plant-parasitic nematodes, their morphology, anatomy, taxonomy, genetics, physiology, ecology, host-parasite relations and control. Recent advances in this field will be emphasized.

BOTN 642 Plant Biochemistry (2) Prerequisite: BOTN 641, or CHEM 461 and 462. A treatment of those aspects of biochemistry unique to plants including photosynthesis, synthesis of plant macromolecules and pertinent aspects of other metabolic processes.

BOTN 644 Plant Biochemistry Laboratory (2) Pre- or corequisite BOTN 642. Use of apparatus and application of techniques in the study of the chemistry of plants and plant materials.

BOTN 645 Growth and Development (2) Prerequisite: BOTN 441. Physiology of plant hormones, control of morphogenesis and regulation of biosynthesis, photomorphogenesis and photoperiodism.

BOTN 650 Mineral Nutrition of Plants (2) Prerequisite: BOTN 441. A study of the inorganic nutrients required for plant growth and development, with emphasis on mechanisms of nutrient uptake, translocation, and mineral metabolism.

BOTN 652 Plant Biophysics (2) Prerequisite: MATH 220, BOTN 441 plus one year of college physics, or

their equivalents. An advanced course dealing with physical and chemical phenomena associated with the study of plants, stress on problem solving.

BOTN 654 Plant Biophysics Laboratory (2) Pre- or corequisite: BOTN 652. Techniques in measurement of and utilization of light and other parameters associated with plants.

BOTN 661 Advanced Plant Ecology (3) Prerequisite: A working knowledge of elementary genetics and calculus, or permission of the instructor. Population dynamics, evolutionary mechanisms, and quantitative aspects of the analysis of natural communities. Special emphasis will be given to recent theoretical developments.

BOTN 672 Physiology of Algae (2) Prerequisite: BOTN 642 or equivalent, or permission of the instructor. A study of the physiology of the algae.

BOTN 689 Special Topics in Botany (1–3) Credit according to time scheduled and organization of course. Maximum credit toward an advanced degree for the individual student at the discretion of the department. This course is organized as lectures, discussions or literature surveys on specialized advanced topics under the direction of visiting lecturers or or resident faculty.

BOTN 698 Seminar in Botany (1) Prerequisite: Permission of the instructor. Discussion of special topics and current literature in all phases of Botany.

BOTN 699 Special Problems in Botany (1–3) Credit according to time and scheduled and organization of course. Maximum credit towards an advanced degree for the individual student at the discretion of the student's advisor. This course emphasizes research on a specialized advanced topic and may consist primarily of experimental procedures under the direction of visiting lecturers or resident faculty.

BOTN 799 Master's Thesis Research (1–6)

BOTN 899 Doctoral Dissertation Research (1–8)

Business and Management Program

Dean: Lamone
Associate Dean:
Assistant Dean: Armistead
Director of Graduate Studies: Nash
Director of MBA & MS Programs: Sharer
Chairpersons: Fromovitz, Gannon, Greer, Haslem, Leete, Loeb
Professors Emeritus: Fisher and Wright
Professors: Bodin, Bradford, Carroll, Dawson, Gannon, Gass, Gordon, Greer, Haslem, Jolson, Kotz, Lamone, Levine, Locke, Loeb, Nash, Paine, Polakoff, Preston, Roberts, Sibley, Taff
Associate Professors: Bartol, Bedingfield, Bloom, Courtright, Edelson, Edmister, Ford, Fromovitz, Golden, Hynes, Kolodny, Kuehl, Leete, Nickels, Poist, Schneier, Shneiderman, Thieblot, Widhelm
Assistant Professors: Alt, Assad, Ball, Boisjoly, Brodie, Carlson, Chow, Corsi, Fanara, Greene, Hamer, Harvey, Koehl, Kumar, Mayer-Sommer, Norland, Sorkin, Spekman, Stagliano, Stiner, Wood

The College of Business and Management offers graduate work leading to the degrees of Master of Business Administration (MBA), Master of Science in Business and Management (MS), and Doctor of Business Administration (DBA). The College's MBA program is accredited nationally by the American Assembly of Collegiate Schools of Business. Only about 200 of the more than 1,000 graduate programs in the country are accredited by the AACSB, a reflection of the quality of faculty, students, curriculum and facilities.

Areas of faculty specialization include accounting; finance; management science and statistics; marketing; organizational behavior and industrial relations; and transportation, business and public policy.

Admission and Degree Information

Admission criteria for the MBA, MS and DBA programs are based on (1) quality of recent undergraduate and graduate course work; (2) score on the Graduate Management Admission Test (GMAT); (3) letters of recommendation; and (4) other relevant information and professional experience with heaviest weight given to (1) and (2).

The College of Business and Management offers an MBA program designed to provide the educational foundation for those students with the potential to exhibit the highest degree of excellence in future careers as professional managers. The MBA program varies in length from 35 to 48 credits depending on the student's previous college preparation. There is no thesis requirement. Successful students in the program are expected to demonstrate the following: (1) a thorough and integrated knowledge of the basic tools, concepts and theories relating to professional management; (2) behavioral and analytical skills necessary to deal creatively and effectively with organizations and management problems; 3) an understanding of the economic, political, technological, and social environments in which organizations operate. 4) a sense of professional and personal integrity and social responsibility in the conduct of managerial affairs both internal and external to the organization.

If the student's prior coursework did not include the program prerequisites, the following 500-level prerequisite courses must be completed with a "B" average as early as possible in the student's graduate program: BMGT 501 (3 hours), BMGT 502 (3 hours), BMGT 503 (3 hours), and BMGT 504 (4 hours). These basic knowledge courses may be waived by the MBA Program Director if equivalent courses have been satisfactorily completed. Students with baccalaureate degrees in business administration from regionally or nationally accredited schools will normally have included the topics covered by these prerequisite courses and may not have to take them.

About two-thirds of the students enrolled are full time and one-third are part time. Full-time students must maintain minimum registration requirements described in this catalog under "Registration and Credits. *Part-time students are required to complete a minimum of 12 credit hours per calendar year.* Should these requirements not be met or should a student's grade point average fall below 3.0, the student will be placed on probation and granted one semester to remedy these deficiencies. Most courses for part-time students will begin at 4:00 and 7:00 p.m. However, there is no guarantee that all courses needed at any one time will be available at those times.

The College's *MS* program is designed for students with an undergraduate degree in Business (Quantitative), Engineering, Sciences, Information and Computer Systems, Mathematics and Economics who want more of a technical education than a broad managerial education. Prerequisites include some or all of the 500-level courses required for the MBA program depending upon the student's background, calculus, probability theory, and knowledge of a higher level algebraic computer language. Thirty credit hours beyond the prerequisites are required with 12 credits to be taken in a core of four courses and the remaining 18 hours to be taken in any one of three areas of concentration (Statistics, Operations Research, and Information Systems Management). A thesis option is offered which will represent 6 credits in the area of concentration. Program progress standards described above for the MBA program are also applicable to the MS program.

The DBA program is designed to produce outstanding scholars in management related disciplines. Graduates of the program are well-qualified to take faculty, research, and professional or administrative positions in colleges and universities, government agencies, private research organizations, or business firms.

Maryland DBA students achieve excellence through (1) course work preparation in basic, major and minor fields (required), supervised teaching during their period of residence (required), independent research culminating in the writing of a doctoral dissertation (required), and joint research with faculty and fellow DBA students (optional). A full time commitment to the program is normally required as a condition for admittance.

Each student's DBA program must be approved initially by the student's major area faculty chairman or his or her representative and reviewed annually with the student. Minor areas must be approved initially by the minor area chairman or his or her designated representative.

Major and minor areas in the college include the following: (1) Accounting, (2) Finance, (3) Management Science and Statistics, (4) Marketing, (5) Organizational Behavior and Organization Theory, (6) Personnel and Labor Relations, (7) Transportation and Physical Distribution.

DBA requirements for the typical student are from 63 to 75 hours, not including dissertation credits. Thirty-three of the hours are devoted to fulfilling the general requirements, discussed below, with the remaining credits distributed among the student's major and minor fields of study.

The general requirements for all DBA students are BMGT 720, BMGT 740, BMGT 750, BMGT 764, two three-credit graduate courses in economics (BMGT 775 may be used as one of the two courses), nine credits in quantitative methods at the 700 level or above approved by the student's faculty chairman, and BMGT 880 plus three additional graduate credits in research methodology.

These general program requirements may be waived by the Director of the Doctoral Program if equivalent courses at AACSB accredited schools have been satisfactorily completed. Some of these courses may be included in the major and minor course requirements.

The DBA student is placed on academic probation after 12 hours unless he or she maintains at least a 3.25 GPA. The probationary period will last one semester, at which time the student will be dismissed unless a 3.25 GPA level is obtained.

The DBA student may select a single major with two minors or a double major. For a single major, the student takes 18 credits beyond the bachelor's degree in the major field, at least 6 of which must be taken in graduate seminars at the 800 level at the University of Maryland. The minors may include areas inside or outside the College of Business and Management. Each minor is comprised of 12 credits.

For a double major, the student takes 21 credit hours in each of two major fields, one of which may be in a discipline outside the College of Business and Management.

Both the single and the double major arrangements comprise 42 credit hours in total. Special permission from the College's graduate committee is required for a double major or a single major with *both* minors in disciplines outside the College of Business and Manage-

ment. Typical outside minors include such areas as Computer Science, Economics, Engineering, Mathematics, Government and Politics, Psychology, and Sociology.

Students take comprehensive examinations in major and minor subject areas. Following successful completion of the written examinations, each student must pass an oral examination given by a committee of the college graduate faculty. Any student receiving a "pass with distinction" in all written examinations will be exempted from the oral comprehensive. Failure to pass any major or minor written comprehensive examination in two attempts will result in termination from the program.

The dissertation proposal is defended by each DBA candidate at an open meeting. All faculty and other DBA students are invited to attend and participate in the proposal defense.

The dissertation must exhibit the candidate's competence in analysis, interpretation, and presentation of research findings, and should be a major contribution to the literature of the field. The candidate must defend his or her dissertation in a final oral dissertation defense.

MBA/JD Joint Program

The College of Business and Management and the School of Law of the University of Maryland at Baltimore offer a joint program of studies leading to MBA and JD degrees. Under the terms of the joint program, a student may earn both degrees in four academic years. The accelerated program is possible because some courses can be credited toward both degrees. Candidates must apply for admission to the Law School at Baltimore as well as to The Graduate School at College Park and must be admitted to both programs.

Under the joint program, 75 credits in law school coupled with 39 credits in business courses (or 26 credits for students who have completed MBA program prerequisites) are required for graduation. Nine credits of law will be substituted for MBA elective coursework. Grade point averages in each program will be computed separately and students must maintain minimum standards in each school to continue in the program. The Graduate School will not accept transfer credit for coursework taken outside the joint program. A student must complete both programs satisfactorily in order to receive both degrees. A student whose enrollment in either program is terminated may elect to complete work for the degree in which he or she remains enrolled but such completion must be upon the same conditions as required of regular (nonjoint program) degree candidates. Student programs must be approved by the law school adviser for the joint program and the MBA Program Director. For further discussion of admission and degree requirements, students should see above and consult the entry in the University of Maryland School of Law catalog.

Facilities and Special Resources

The faculty has been recruited from the graduate programs of leading universities in the nation. They are dedicated scholars, teachers, and professional leaders, unusual in their comparative youth, academic excellence, and strong commitment to the education of the professional manager.

Special programs offered by the College include an Executives-in-Residence Program and an MBA practicum course, BMGT 791, in which students research a problem of significant management concern in a participating firm or agency. Through graduate program requirements and faculty research activities students gain exposure to state and federal agencies and to the vast educational, research, library, and cultural resources of Washington, D.C.

The students also have access to the exceptional academic and professional resources of the College Park campus including excellent library and computer facilities. A remote computer terminal and on-line teletype facilities are located in the building.

Financial Assistance

Financial aid is available to qualified students in the form of fellowships and graduate assistantships, and, for DBA students, assistant instructorships.

Additional Information

The College has available brochures which give specific degree requirements for the MBA and DBA programs. Initial inquiries should be directed to:

Director of the MBA Program College of Business and Management or Director of the Doctoral Program College of Business and Management

Courses

BMGT 401 Introduction to Systems Analysis (3) Students enrolled in the College of Business and Management curricula will register for IFSM 436. For detailed information on prerequisites and descriptions of the course, refer to IFSM 436. The credits earned in IFSM 436 may be included in the total credits earned in the area of concentration in Business and Management.

BMGT 410 Fund Accounting (3) Prerequisite: BMGT 310. An introduction to the fund-based theory and practice of accounting as applied to governmental entities and other not-for-profit associations.

BMGT 417 Advanced Tax Accounting (3) Prerequisites: BMGT 311 and 323. Federal taxation of corporations, partnerships, fiduciaries, and gratuitous transfers. Tools and techniques of tax research for compliance and planning.

BMGT 420 Undergraduate Accounting Seminar (3) Prerequisite: Senior standing as an accounting major or consent of instructor. Enrollment limited to upper one-third of senior class. Seminar coverage of outstanding current non-text literature, current problems and case studies in accounting.

BMGT 421 Undergraduate Accounting Seminar (3) Prerequisite: Senior standing as an accounting major or consent of instructor. Enrollment limited to upper one-third of senior class. Seminar coverage of outstanding current non-text literature, current problems and case studies in accounting

BMGT 422 Auditing Theory and Practice (3) Prerequisite: BMGT 311. A study of the principles and problems of auditing and application of accounting principles to the preparation of audit working papers and reports.

BMGT 423 Apprenticeship in Accounting (0) Prerequisites: Minimum of 20 semester hours in accounting and the consent of the accounting staff. A period of apprenticeship is provided with nationally known firms of certified public accountants from about January 15 to February 15.

BMGT 424 Advanced Accounting (3) Prerequisite: BMGT 311. Advanced accounting theory applied to specialized topics and current problems. Emphasis on consolidated statements and partnership accounting.

BMGT 425 CPA Problems (3) Prerequisite: BMGT 424 or consent of instructor. An intensive study of various accounting areas covered in the Uniform CPA examination.

BMGT 426 Advanced Cost Accounting (3) Prerequisite: BMGT 321. Advanced cost accounting with emphasis on managerial aspects of internal record-keeping and control systems.

BMGT 427 Advanced Auditing Theory and Practice (3) Prerequisite: BMGT 422. Advanced auditing theory and practice and report writing.

BMGT 430 Linear Statistical Models in Business (3) Prerequisite: BMGT 230 or consent of instructor. Model building involving an intensive study of the general linear stochastic model and the applications of this model to business problems. The model is derived in matrix form and this form is used to analyze both the regression and anova formulations of the general linear model.

BMGT 431 Design of Statistical Experiments in Business (3) Prerequisite: BMGT 230 or 231. Surveys anova models, basic and advanced experimental design concepts. Non-parametric tests and correlation are emphasized. Applications of these techniques to business problems in primarily the marketing and behavioral sciences are stressed.

BMGT 432 Sample Survey Design for Business and Economics (3) Prerequisite: BMGT 230 or 231. Design of probability samples. Simple random sampling, stratified random sampling, systematic sampling, and cluster sampling designs are developed and compared for efficiency under varying assumptions about the population sampled. Advanced designs such as multistage cluster sampling and replicated sampling are surveyed. Implementing these techniques in estimating parameters of business models is stressed.

BMGT 433 Statistical Decision Theory in Business (3) Prerequisite: BMGT 231 or consent of instructor. Bayesian approach to the use of sample information in decision-making. Concepts of loss, risk, decision criteria, expected returns, and expected utility are examined. Application of these concepts to decision-making in the firm in various contexts are considered.

BMGT 434 Operations Research I (3) Prerequisite: BMGT 230, MATH 240 or permission of instructor. Designed primarily for students majoring in management science, Information Systems Management.

BMGT 435 Operations Research 22 (3) Prerequisite: BMGT 434, or permission of instructor. The second semester of a two-part introduction to operations research. The primary emphasis is on stochastic models in management science. Topics include stochastic linear programming, probabilistic dynamic programming, Markov processes, probabilistic inventory models, queueing theory and simulation.

BMGT 436 Applications of Mathematical Programming in Management Science (3) Prerequisite: BMGT 434 or permission of instructor. Theory and applications of linear, integer, and nonlinear programming models to management decisions. Topics covered include the basic theorems of linear programming; the matrix formulation of the simplex, and dual simplex algorithms; decomposition, cutting plane, branch and bound, and implicit enumeration algorithms; gradient based algorithms; and quadratic programming. Special emphasis is placed upon model formulation and solution using prepared computer algorithms.

BMGT 438 Topics in Statistical Analysis for Business Management (3) Prerequisite: BMGT 430 and MATH 240 or permission of the instructor. Selected topics in statistical analysis which are relevant to management for students with knowledge of basic statistical methods. Topics include evolutionary operation and response surface analysis, forecasting techniques, pathologies of the linear model and their remedies, multivariate statistical models, and nonparametric models.

BMGT 440 Financial Management (3) Prerequisite: BMGT 340. Analysis and discussion of cases and readings relating to financial decisions of the firm. The application of finance concepts to the solution of financial problems is emphasized.

BMGT 443 Security Analysis and Valuation (3) Prerequisite: BMGT 343. Study and application of the concepts, methods, models, and empirical findings to the analysis, valuation, and selection of securities, especially common stock.

BMGT 445 Commercial Bank Management (3) Prerequisites: BMGT 340 and ECON 430. Analysis and discussion of cases and readings in comercial bank management. The loan function is emphasized; also the management of liquidity reserves, investments for income, and source of funds. Bank objectives, functions, policies, organization, structure, services, and regulation are considered.

BMGT 450 Marketing Research Methods (3) Prerequisites: BMGT 230 and 350. Recommended that BMGT 430 be taken prior to this course. This course is intended to develop skill in the use of scientific methods in the acquisition, analysis and interpretation of marketing data. It covers the specialized fields of marketing research: the planning of survey projects, sample design, tabulation procedure and report preparation.

BMGT 451 Consumer Analysis (3) Prerequisites: BMGT 350 and 351. Recommended that PSYC 100 and 221 be taken prior to this course. Considers the growing importance of the American consumer in the marketing system and the need to understand him. Topics include the foundation considerations underlying consumer behavior such as economic, social, psychological and cultural factors. Analysis of the consumer in marketing situations-as a buyer and user of products and services-and in relation to the various individual social and marketing factors affecting his behavior. The influence of marketing communications is also considered.

BMGT 453 Industrial Marketing (3) Prerequisites: BMGT 350 plus one other marketing course. The industrial and business sector of the marketing system is considered rather than the household or ultimate consumer sector. Industrial products range from raw materials and supplies to the major equipment in a plant, business office, or institution. Topics include product planning and introduction, market analysis and forecasting, channels, pricing, field sales force management, advertising, marketing cost analysis, and government relations. Particular attention is given to industrial, business and institutional buying policies and practice and to the analysis of buyer behavior.

BMGT 454 International Marketing (3) Prerequisites: BMGT 350 plus any other marketing course. A study of the marketing functions from the viewpoint of the international executive. In addition to the coverage of international marketing policies relating to product adaptation, data collection and analysis, channels of distribution, pricing, communications, and cost analysis, consideration is given to the cultural, legal, financial, and organizational aspects of international marketing.

BMGT 455 Sales Management (3) The role of the sales manager, both at headquarters and in the field, in the management of people, resources and marketing functions. An analysis of the problems involved in sales organization, forecasting, planning, communicating, evaluating and controlling. Attention is given to the application of quantitative techniques and pertinent behavioral science concepts in the management of the sales effort and sales force.

BMGT 456 Advertising (3) Prerequisite: BMGT 354. The role of advertising in the American economy; the impact of advertising on our economic and social life, the methods and techniques currently applied by advertising practitioners; the role of the newspaper, magazine, and other media in the development of an advertising campaign, modern research methods to improve the effectiveness of advertising and the organization of the advertising business. (Not open for credit to students with credit for BMGT 352.)

BMGT 457 Marketing Policies and Strategies (3) Prerequisite: Three courses in marketing. Integrative decision making in marketing. Emphasis on consumer and market analysis and the appropriate decision models. Case studies are included.

BMGT 460 Personnel Management—Analysis and Problems (3) Prerequisite: BMGT 360. Recommended, BMGT 230. Research findings, special readings, case analysis, simulation, and field investigations are used to develop a better understanding of personnel problems, alternative solutions and their practical ramifications.

BMGT 462 Labor Legislation (3) Case method analysis of the modern law of industrial relations. Cases include the decisions of administrative agencies, courts and arbitration tribunals.

BMGT 463 Public Sector Labor Relations (3) Prerequisite: BMGT 362 or permission of instructor. Development and structure of labor relations in public sector employment; federal, state, and local government responses to unionization and collective bargaining.

BMGT 464 Organizational Behavior (3) Prerequisite: BMGT 364. An examination of research and theory concerning the forces which contribute to the behavior of organizational members. Topics covered include: work group behavior, supervisory behavior, intergroup relations, employee goals and attitudes, communication problems, organizational change, and organizational goals and design.

BMGT 467 Undergraduate Seminar in Personnel Management (3) Prerequisite: Consent of instructor. This course is open only to the top one-third of undergraduate majors in personnel and labor relations and is offered during the fall semester of each year. Highlights major developments. Guest lecturers make periodic presentations.

BMGT 470 Land Transportation Systems (3) Prerequisite: BMGT 370. Overall view of managerial problems facing land carriers; emphasis on rail and motor modes of transportation.

BMGT 471 Air and Water Transportation Systems (3) Prerequisite: BMGT 370. Overall view of managerial problems facing air and water carriers; emphasis on international and domestic aspects of air and water modes of transportation. Not open for credit to students who have credit for BMGT 472.

BMGT 473 Advanced Transportation Problems (3) Prerequisite: BMGT 370. A critical examination of current government transportation policy and proposed solutions. Urban and intercity managerial transport problems are also considered.

BMGT 474 Urban Transport and Urban Development (3) Prerequisite: ECON 203 or 205. An analysis of the role of urban transportation in present and future urban development. The interaction of transport pricing and service, urban planning, institutional restraints, and public land uses is studied.

BMGT 475 Advanced Logistics Management (3) Prerequisites: BMGT 370, 372, 332. Application of the concepts of BMGT 372 to problem solving and special projects in logistics management; case analysis is stressed.

BMGT 480 Legal Environment of Business (3) The course examines the principal ideas in law stressing those which are relevant for the modern business executive. Legal reasoning as it has evolved in this country will be one of the central topics of study. Several leading antitrust cases will be studied to illustrate vividly the reasoning process as well as the interplay of business, philosophy, and the various conceptions of the nature of law which give direction to the process. Examination of contemporary legal problems and proposed solutions, especially those most likely to affect the business community, are also covered.

BMGT 481 Public Utilities (3) Prerequisite: ECON 203 or 205. Using the regulated industries as specific examples, attention is focused on broad and general problems in such diverse fields as constitutional law, administrative law, public administration, government control of business, advanced economic theory, accounting, valuation and depreciation, taxation, finance, engineering, and management.

BMGT 482 Business and Government (3) Prerequisite: ECON 203 or 205. A study of the role of government in modern economic life. Social control of business as a remedy for the abuses of business enterprise arising from the decline of competition. Criteria of limitations on government regulation of private enterprise.

BMGT 485 Advanced Production Management (3) Prerequisite: BMGT 385. A study of typical problems encountered by the factory manager. The objective is to develop the ability to analyze and solve problems in management control of production and in the formulation of production policies. Among the topics covered are plant location, production planning and control, methods analysis, and time study.

BMGT 490 Urban Land Management (3) Covers the managerial and decision making aspects of urban land and property. Included are such subjects as land use and valuation matters.

BMGT 493 Honors Study (3) First semester of the senior year. Prerequisite: Candidacy for honors in Business and Management. The course is designed for honors students who have elected to conduct intensive study (independent or group). The student will work under the direct guidance of a faculty advisor and the chairman of the honors committee. They shall determine that the area of study is of a scope and intensity deserving of a candidate's attention. Formal written and/or oral reports on the study may be required by the faculty advisor and/or chairman of the honors program. Group meetings of the candidates may be called at the discretion of the faculty advisors and/or chairman of the honors committee.

BMGT 494 Honors Study (3) Second semester of the senior year. Prerequisite: BMGT 493, and continued candidacy for honors in Business and Management. The student shall continue and complete the research initiated in BMGT 493; additional reports may be required at the discretion of the faculty advisor and honors program chairman. Group meetings may be held.

BMGT 495 Business Policies (3) Prerequisites: BMGT 340, 350, 364, and senior standing. A case study course in which the aim is to have the student apply what they have learned of general management principles and their specialized functional applications to the overall management function in the enterprise.

BMGT 496 Business and Society (3) Prerequisite: One course in BMGT or consent of instructor. Normative role of business in society; consideration of the sometimes conflicting interests and claims on the firm and its objectives.

BMGT 498 Special Topics in Business and Management (3) Prerequisite: Permission of instructor. Special topics in Business and Management designed to meet the changing needs and interests of students and faculty. Repeatable to a maximum of six credits if the subject matter is different.

BMGT 501 Business Functions (3) Intensive review of the management functions in the business enterprise, the development of management thought, and the nature of the managerial process. Credit not applicable towards graduate degrees.

BMGT 502 Public Policy and the Environments of Business (3) Intensive review of the social, economic and legal environments of the business enterprise. Credit not applicable towards graduate degrees.

BMGT 503 Accounting and Information Systems (3) Intesive review of the technical and conceptual aspects of financial accounting and accounting information systems as they apply to the business enterprise. Credit not applicable towards graduate degrees.

BMGT 504 Quantitative Methods and Computer Laboratory (4) Intensive review of the mathematical, statistical, and computer concepts, methods and skills requisite to the analysis of business problems. Credit not applicable towards graduate degrees.

BMGT 606 Information Systems Technology (3) Introduction to graduate courses in IFSM, a survey for interested graduate students in other fields. The concepts, theory and techniques of information systems. The system life cycle. The role of information systems in the management and control of the organization. Effectiveness measures of information systems. Case studies of information systems as developed by industry and government. Societal impact.

BMGT 701 Management Analysis and Communication (1) Analysis of business problems through case studies to generate written and/or oral reports describing problem definition, alternative solutions, decision criteria, and recommended solutions.

BMGT 708 Special Topics in Business and Management (3) Prerequisite: Admission to a graduate program in Business and Management or approval of the college program director. Selected advanced topics in the various fields of graduate study in Business and Management. With permission of the college program director, may be repeated to a maximum of six credits provided the content is different.

BMGT 710 Advanced Accounting Theory (3) The study of the theoretical and conceptual foundations for generally accepted accounting principles and practices. The basic postulates, assumptions, and standards which underlie the measurement criteria and practices of financial accounting.

BMGT 712 Accounting in Regulated Industries (3) Study of the unique accounting problems of industries subject to regulation by governmental agencies.

BMGT 713 The Impact of Taxation on Business Decisions (3) The impact of tax law and regulations on alternative business strategies with particular emphasis on the large, multidivisional firm. Problems of acquisitions, mergers, spinoffs, and other divestures

from the viewpoint of profit planning, cash flow, and tax deferment

BMGT 715 International Auditing (3) International accounting, its problems and organizations associated with the study of the issues involved; international standards of accounting and auditing; national differences in accounting thought and practice.

BMGT 720 Managerial Accounting I (3) The use of accounting data for corporate financial planning and control. Organization for control, profit planning, budgeting, relevant costing, return on investment, and administration of the controllership function in smaller organizations.

BMGT 721 Requirements Analysis and Logical Design of Information Systems (3) Prerequisite: IFSM 606 or permission of instructor. Prerequisite: IFSM 606 or permission of instructor. The life cycle of an information processing system. The early part of the life cycle, i.e., the perception of need and the collection of requirements. Feasibility analysis of proposed information processing systems. Techniques for statement of the requirements of an information processing system, ranging from the early industrial engineering originated methods to current computer-aided ones. Concepts of logical design from the synthesis of requirements.

BMGT 722 The Physical Design of Information Systems (3) Prerequisite: IFSM 606 or permission of instructor. Mapping the logical design to the available hardware and off-the-shelf software in the 'best' way possible. Human factors and social implications.

BMGT 723 Database Technology (3) Prerequisite: IFSM 606 or permission of instructor. The concepts, theory and models of data, its structure, manipulation, and storage. The various architectures of data management systems. Evaluation and selection of database systems.

BMGT 724 Application of Management Methods to Information Systems (3) Prerequisities: IFSM 606, BMGT 734 or equivalent. Theory and practice of management techniques from strategic planning to system acquisition to operation as applied to information systems. Methods of organizing the information center, allocation of chargeback policies, performance monitoring and projection, security and integrity evaluation, project selection and staffing, outside services for resource leveling.

BMGT 730 Bayesian Statistics and Decision Theory (3) Prerequisite: BMGT 732 or consent of instructor. Concepts and methods of Bayesian statistical decision theory with application to business problems.

BMGT 731 Theory of Survey Design (3) Examines the usefulness of statistical principles in survey design. Topics include: The nature of statistical estimation, the differential attributes of different estimators, the merits and weaknesses of available sampling methods and designs, the distinctive aspects of simple random samples, stratified random samples, and cluster samples, ratio estimates and the problems posed by biases and non-sampling errors.

BMGT 732 Management Statistics and Computer Laboratory (4) Prerequisite: BMGT 504 or permission of college. Application of statistical concepts to solution of business problems; laboratory use of computer packages.

BMGT 734 Management Science and Computer Laboratory (4) Prerequisite: BMGT 504 or permission of college. Application of management science concepts to solution of business problems; laboratory use of computer packages.

BMGT 735 Application of Management Science (3) Prerequisite: BMGT 734 or consent of instructor. Selected topics and case studies in the application of management science to decision making in various functional fields.

BMGT 736 Philosophy and Practice of Management Science (3) Prerequisite: BMGT 734 or 735, or consent of instructor. Critical examination of the philosophy underlining the techniques and methodology of management science from a systems analysis point of view.

BMGT 737 Management Simulation (3) Prerequisite: BMGT 734 or consent of instructor. Methodology of systems simulation, Monte Carlo simulation, and discrete simulation. Verification and validation of simulation models with computer applications.

BMGT 740 Financial Management (3) Prerequisite: BMGT 501, 503 and 504 or permission of college. The role of financial management in the firm. Topics include valuation and leverage, capital budgeting, cost of capital, dividend policy, long-term financing, working capital management, short-term financing, intermediate-term financing and leasing, and mergers. Required of all MBA students.

BMGT 741 Advanced Financial Management (3) Prerequisite: BMGT 740. Concepts underlying financial decision making in the firm. Case studies, model building and applications in financial theory and management.

BMGT 743 Investment Management (3) Prerequisite: BMGT 740. Methods of security selection and portfolio management in the debt and equity markets. Investment alternatives, securities markets, bond and common stock valuation, options, portfolio theory, and behavior of stock prices.

BMGT 745 Financial Institutions Management (3) Prerequisite: BMGT 740. The role of financial management in financial institutions. The economic role and regulation of financial institutions, analysis of risks and returns on financial assets and liabilities, and the structure of assets, liabilities and capital.

BMGT 746 International Financial Management (3) Prerequisite: BMGT 740. The role of financial management in the multinational firm. The financing and managing of foreign investments, assets, currencies, imports and exports. National and international financial institutions and markets.

BMGT 747 Risk Management (3) Prerequisites: BMGT 720, 732, 740. Strategies for pure risk management, including property, personnel, and liability exposures. Quantitative decision-making techniques applied to self-insurance, insurance, and noninsurance transfers in organizations.

BMGT 750 Marketing Management (3) Prerequisite: BMGT 501 or permission of college. Analysis of marketing problems and evaluation of specific marketing efforts as they contribute to a coordinated marketing program. Product, price and service policies; market characteristics; channel selection; promotion and organization structure.

BMGT 751 Marketing Communications Management (3) Required for M.B.A. candidates concentrating in marketing. Concerned with the part that advertising, promotion, public relations and related efforts play in the accomplishment of a firm's total marketing objectives. Its purpose is to develop competence in the formulation of mass communications, objectives in budget optimization, media appraisal, theme selection, program implementation and management, and results measurement.

BMGT 752 Marketing Research Methods (3) Required for M.B.A. candidates concentrating in marketing. Deals with the process of acquiring, classifying and interpreting primary and secondary marketing data needed for intelligent, profitable marketing decisions. Through readings, discussion, and case studies, efforts are made to develop skill in evaluating the appropriateness of alternative methodologies such as the inductive, deductive, survey, observational, and experimental. Consideration is also given to recent developments in the systematic recording and use of internal and external data needed for marketing decisions.

BMGT 753 International Marketing (3) Deals with environmental, organizational, and financial aspects of international marketing as well as problems of marketing research, pricing, channels of distribution, product policy, and communications which face U.S. firms trading with foreign firms or which face foreign firms in their operations.

BMGT 754 Buyer Behavior Analysis (3) A systematic examination and evaluation of the literature, research tradition and theory of buyer behavior in the market place from a fundamental and applied perspective. The cognitive and behavioral bases underlying the buying process of individuals and institutions is investigated to better understand, predict, and influence the process through the effective utilization of the firms' marketing resources.

BMGT 760 Personnel Administration (3) Examination of the human resource function in organizations. Human resource planning, procurement and selection, training and development, performance appraisal, wage and salary administration, and equal employment opportunity.

BMGT 761 Problems and Applications in Personnel Administration (3) Prerequisite: BMGT 760 or equivalent, or permission of instructor. Applications in the design, implementation, and evaluation of human resource management programs. Experential learning activities and simulations.

BMGT 762 Problems and Issues in Collective Bargaining (3) Current problems and issues in collective bargaining, including methods of handling industrial disputes, legal restrictions on various collective bargaining activities, theory and philosophy of collective bargaining, and internal union problems.

BMGT 763 Administration of Labor Relations (3) Analysis of labor relations at the plant level with emphasis on the negotiation and administration of labor contracts. Union policy and influence on personnel management activities.

BMGT 764 Behavioral Factors in Management (3) Prerequisite: BMGT 501 or permission of college. Analysis of the influence of Behavioral Sciences on the theory and practice of management.

BMGT 765 Application of Behavioral Science to Business (3) Prerequisite: BMGT 764 or permission of professor. Stresses case analysis of behavioral knowledge applied to management problems. Typical topics include analysis of modes for introducing change, group versus organizational goals, organizational barriers to personal growth, the effect of authority systems on behavior, and the relationship between technology and social structure.

BMGT 770 Transportation Theory and Analysis (3) Examines the transportation system and its components. Key topics in the development and present form of transportation in both the United States and other countries are considered together with theoretical concepts employed in the analysis of transport problems.

BMGT 771 Transport and Public Policy (3) An intensive study of the nature and consequences of relations between governments and agencies thereof, carriers in the various modes, and users of transport services. Typical areas subjected to examination and analysis include: the control of transport firms by regulatory bodies, taxation of carriers, methods employed in the allocation of funds to the construction, operation, and maintenance of publicly-provided transport facilities, and the direct subsidization of services supplied by privately-owned entities. Additional problems considered include labor and safety. Comparative international transport policies and problems are also examined.

BMGT 772 Management of Physical Distribution (3) Focuses on managerial practices required to fulfill optimally the physical movement needs of extractive, manufacturing, and merchandising firms. Attention is given to the total cost approach to physical distribution. Interrelations among purchased transport services, privately-supplied transport services, warehousing, inventory control, materials handling, packaging, and plant location are considered. An understanding of the communications network to support physical distribution is developed in conjunction with study of the problems of coordination between the physical movement management function and other functional areas within the business firm—such as accounting, finance, marketing, and production.

BMGT 773 Transportation Strategies (3) Treats organization structure, policies, and procedures employed in the administration of inter- and intraurban transport firms. Problems receiving attention include managerial development, operational and financial planning and control, demand analysis, pricing, promotional policies, intra- and intermodal competitive and complementary relationships, and methods for accommodating public policies designed to delimit the managerial discretion of carrier executives. Administrative problems peculiar to publicly-owned and operated transport entities are also considered.

BMGT 774 Private Enterprise and Public Policy (3) Examines the executive's social and ethical responsibilities to his employees, customers and to the general public. Consideration is given to the conflicts occasioned by competitive relationships in the private sector of business and the effect of institutional restraints. The trends in public policy and their future effect upon management are examined. For comparative purposes, several examples of planned societies are considered.

BMGT 775 Product, Production and Pricing Policy (3) Required of M.B.A. candidates. The application of

economic theory to the business enterprise in respect to the determination of policy and the handling of management problems with particular reference to the firm producing a complex line of products, nature of competition, pricing policy, interrelationship of production and marketing problems, basic types of cost, control systems, theories of depreciation and investment and the impact of each upon costs

BMGT 777 Policy Issues in Public Utilities (3) A critical analysis of current developments in regulatory policy and issues arising among public utilities, regulatory agencies, and the general public. Emphasis is placed on the electric, gas, water, and communications industries in both the public and private sectors of the economy. Changing and emerging problems stressed include those pertinent to cost analysis, depreciation, finance, taxes, rate of return, the rate base, differential rate-making, and labor. In addition, the growing importance of technological developments and their impact on state and federal regulatory agencies are explored.

BMGT 781 International Business Administration (3) Examines the international business environment as it affects company policy and procedures. Integrates the business functions undertaken in international operations through analysis in depth and comprehensive case studies. This course can be credited toward the 18-hour requirement for a major field in the D.B.A. program.

BMGT 782 Management of the Multinational Firm (3) Deals with the problems and policies of international business enterprise at the management level. Considers management of a multinational enterprise as well as management within foreign units. The multinational firm as a socio-econometric institution is analyzed in detail. Cases in comparative management are utilized.

BMGT 785 Management Planning and Control Systems (3) Prerequisite: BMGT 501 or permission of college. Analysis of planning and control systems as they relate to the fulfillment of organizational objectives. Identification of organizational objectives, responsibility centers, information needs, and information networks. Case studies of integrated planning and control systems.

BMGT 786 Development and Trends in Production Management (3) Case studies of production problems in a number of industries. Focuses attention on decisions concerning operating programs and manufacturing policies at the top level of manufacturing. Basic concepts of process and product technology are covered, taking into consideration the scale, operating range, capital cost, method of control, and degree of mechanization at each successive stage in the manufacturing process.

BMGT 790 Total Enterprise Strategy (3) Prerequisite: BMGT 501, 502, 503 and 504, or permission of college. Case studies and research in the identification of management problems, the evaluation of alternative solutions, and the recommendation for management implementation.

BMGT 791 Total Enterprise Strategy-Management Practicum (3) Prerequisite: BMGT 501, 502, 503 and 504, and permission of director of MBA program. Experiental research project in the identification of management problems, the evaluation of alternative solutions, and the recommendation for management.

BMGT 799 Master's Thesis Research (1–6)

BMGT 808 Doctoral Seminar (3) Prerequisite: Admission to the D.B.A. program or approval of the College Director of Graduate Studies. Selected advanced topics in the various fields of doctoral study in business and management. With permission of the College Director of Graduate Studies, may be repeated provided the content is different.

BMGT 811 Seminar in Accounting Theory (3) Prerequisite: BMGT 710 or equivalent. Seminar in the continuing development of the fundamental theoretical framework of accounting.

BMGT 814 Current Problems of Professional Practice (3) Generally accepted auditing standards, auditing practices, legal and ethical responsibilities, and the accounting and reporting requirements of the securities and exchange commission.

BMGT 821 Managerial Accounting II (3) Prerequisite: BMGT 720 or equivalent. Seminar in the management and controllership aspects of accounting in large business organizations.

BMGT 828 Independent Study in Business and Management (1–9)

BMGT 830 Operations Research: Linear Programming (3) Prerequisite: MATH 240 or equivalent, or permission of instructor. Concepts and applications of linear programming models, theoretical development of the simplex algorithm, and primal-dual problems and theory.

BMGT 831 Operations Research: Extension of Linear Programming and Network Analysis (3) Prerequisite: BMGT 830 or equivalent, or permission of instructor. Concepts and applications of network and graph theory in linear models with emphasis on computional algorithms.

BMGT 832 Operations Research: Optimization and Nonlinear Programming (3) Prerequisites: BMGT 830 and MATH 241 or equivalent, or permission of instructor. Theory and applications of algorithmic approaches to solving unconstrained and constrained non-linear optimization problems. The Kuhn Tucker conditions, Lagrangian and duality theory, types of convexity, and convergence criteria. Feasible direction procedures, penalty and barrier techniques, and cutting plane procedures.

BMGT 833 Operations Research: Integer Programming (3) Prerequisite: BMGT 830 and MATH 241 or equivalent, or permission of instructor. Theory, applications, and computational methods of interger optimization. Zero-one implicit enumeration, branch and bound methods, and cutting plane methods.

BMGT 834 Operations Research: Probabilistic Models (3) Prerequisites: MATH 241 and STAT 400 or equivalent, or permission of instructor. Theoretical foundations for the construction, optimization, and applications of probabilistic models. Queuing theory, inventory theory, Markov processes, renewal theory, and stochastic linear programming.

BMGT 835 Simulation and Design of Experiments (3) Prerequisites: Knowledge of fortran programming, BMGT 732 and 734 or equivalent, or permission of instructor. Statistical design and analysis of simulation experiments.

BMGT 841 Seminar in Corporate Finance (3) Prerequisite: Permission of instructor. Seminar in selected classic and current theoretical and empirical research in corporate finance.

BMGT 843 Seminar in Portfolio Theory (3) Prerequisite: Permission of instructor. Seminar in selected classic and current theoretical and empirical research in portfolio theory.

BMGT 845 Seminar in Financial Institutions and Markets (3) Prerequisite: Permission of instructor. Seminar in selected classic and current theoretical and empirical research in financial institutions and markets.

BMGT 850 Marketing Channels Analysis (3) Focuses on the fundamentals explain alternate channels of distribution and the roles played by various intermediaries, the evolution of business structures in marketing, reasons for change, and projected marketing patterns for the future. M.B.A. candidates may register with permission of instructor.

BMGT 851 Quantitative Methods in Marketing—Demand and Cost Analysis (3) Consideration is given to quantitative methods in the analysis and prediction of market demand and marketing costs. Topics in connection with demand include market potentials, sales forecasting, consumer analysis, promotional and pricing results, and the like. Cost analysis focuses on allocation of costs by marketing functions, products, territories, customers and marketing personnel. Statistical techniques, mathematics, models and other methods are utilized in the solution of marketing problems. M.B.A. candidates may register with permission of instructor.

BMGT 852 Theory in Marketing (3) An inquiry into the problems and elements of theory development in general with specific reference to the field of marketing. A critical analysis and evaluation of past and contemporary efforts to formulate theories of marketing and to integrate theories from the social sciences into a marketing framework. Attention is given to the development of concepts in all areas of marketing thought and to their potential application in the business firm.

BMGT 860 Seminar in Human Resource Planning and Selection (3) Prerequisite: BMGT 760 or permission of instructor. Seminar in selected theoretical and empirical literature in human resource planning, forecasting, and staffing.

BMGT 861 Seminar in Performance Appraisal and Training (3) Prerequisite: BMGT 760 or permission of instructor. Seminar in selected theoretical and empirical literature in performance appraisal and training.

BMGT 862 Seminar in Compensation Administration (3) Prerequisite: BMGT 760 or permission of instructor. Seminar in selected theoretical and empirical literature in the compensation of human resources.

BMGT 863 Seminar: The Organization and the Individual (3) Prerequisite: BMGT 764 or equivalent, or permission of instructor. Seminar in the literature on the relationship between individual and organizational characteristics.

BMGT 864 Seminar in Interpersonal Relations and the Group Process in Organizations (3) Prerequisite: BMGT 764 or equivalent, or permission of instructor. Emphasis on the literature of small group behavior among industrial work groups, white-collar work groups, professional staff, and managerial units.

BMGT 865 Seminar in Comparative Theories of Organization (3) Prerequisite: BMGT 764 or equivalent, or permission of instructor. Emphasis on the interdisciplinary literature on classical management, systems, and contingency theories of organization.

BMGT 866 Seminar in Organizational Conflict and Change (3) Prerequisite: BMGT 764 or equivalent, or permission of instructor. Emphasis on the introduction of planned and systematic changes in small work groups, organizational subsystems, and the entire or organization through the use of behavioral science techniques.

BMGT 872 Business Logistics (3) Concentrates on the design and application of methods for the solution of advanced physical movement problems of business firms. Provides thorough coverage of a variety of analytical techniques relevant to the solution of these problems. Where appropriate, experience will be provided in the utilization of computers to assist in managerial logistical decision-making.

BMGT 873 Transportation Science (3) Focuses on the application of quantitative and qualitative techniques of analysis to managerial problems drawn from firms in each of the various modes of transport. Included is the application of simulation to areas such as the control of equipment selection and terminal and line operations. The application of advanced analytical techniques to problems involving resource use efficiency within the transportation industry and between transportation and other sectors of the economy is an integral part of the course.

BMGT 880 Business Research Methodology (3) Covers the nature, scope, and application of research methodology. The identification and formulation of research designs applicable to business and related fields. Required of D.B.A. students.

BMGT 899 Doctoral Dissertation Research (1–8)

Chemical Engineering Program

Professor and Director: Smith
Professor and Department Chairman: Cadman
Professors: Beckmann, Birkner[2], Gentry[3], Regan, Schroeder[1], Smith
Adjunct Professors: Bolsaitis
Associate Professors: Gasner, Hatch
Assistant Professors: Burka, Finger[1], King

[1]part time
[2]joint appointment with Civil Engineering
[3]joint appointment with Institute for Physical Science and Technology

An individual plan of graduate study compatible with the student's interest and background is established between the student, his advisor, and the Department Chairman. The general chemical engineering program is focused on four major areas; applied polymer science, bio-

chemical engineering, environmental and energy-related engineering, process and analysis simulation.

Admission and Degree Information

The programs leading to the M.S. and Ph.D. degrees are open to qualified students holding the B.S. degree. Admission may be granted to students with degrees in any of the engineering and science areas from accredited programs. In some cases it may be necessary to require courses to fulfill the background. The general regulations of the Graduate School apply in reviewing applications.

The candidate for the M.S. degree has the choice of following a plan of study with or without thesis. The equivalent of at least three years of full-time study beyond the B.S. degree is required for the Ph.D. degree. All students seeking graduate degrees in Chemical Engineering must enroll in ENCH 610, 620, 630, and 640. In addition to the general rules of the Graduate School certain special degree requirements are set forth by the Department in its departmental publications.

Facilities and Special Resources

A number of special facilities are available for graduate study and research and are coordinated through the Laboratory for Radiation and Polymer Science, the Laboratory for Process Analysis and Simulation, the Laboratory for Biochemical Engineering and Environmental Studies, and the Nuclear Reactor Facility. These laboratories contain analog and digital process control computers, a gamma radiation facility, an electron accelerator, an electron paramagnetic resonance spectrometer, crystal growth and mechanical testing equipment, and X-ray units.

Courses

ENCH 425 Transport Processes II—Heat Transfer (3) Steady and unsteady state conduction, convective heat transfer, radiation, design of condensers, heat exchangers, evaporators, and other types of heat transfer equipment. Prerequisite: MATH 246. Pre- or corequisite: ENCH 280.

ENCH 427 Transport Processes III—Mass Transfer (3) Steady and unsteady state molecular diffusion, inter-phase transfer, simultaneous heat and mass transfer, boundary layer theory, mass transfer and chemical reaction. Design applications in humidification, gas absorption, distillation, extraction, adsorption and ion exchange.

ENCH 437 Chemical Engineering Laboratory (3) Application of chemical engineering process and unit operation principles in small scale semi-commercial equipment. Data from experimental observations are used to evaluate performance and efficiency of operations. Emphasis on correct presentation of results in report form. Prerequisites: ENCH 427, ENCH 440, ENCH 442.

ENCH 440 Chemical Engineering Kinetics (3) Fundamental of chemical reaction kinetics and their application to the design and operation of chemical reactors. Reaction rate theory, homogeneous reactions and catalysis electrochemical reactions. Catalytic reactor design. Prerequisites: ENCH 300, ENCH 325, CHEM 481.

ENCH 442 Chemical Engineering Systems Analysis (3) Dynamic response applied to process systems. Goals and modes of control, Laplace transformations, analysis and synthesis of simple control systems, closed loop response, dynamic testing. Prerequisites: ENCH 300, ENCH 425.

ENCH 444 Process Engineering Economics and Design I (3) Principles of chemical engineering economics and process design. Emphasis on equipment types, equipment design principles, capital cost estimation, operating costs, and profitability. Prerequisites: ENCH 427, ENCH 440, ENCH 442.

ENCH 445 Process Engineering Economics and Design II (3) Application of chemical engineering principles for the design of process equipment. Typical problems in the design of chemical plants. Comprehensive reports are required. Prerequisite: ENCH 427.

ENCH 446 Process Engineering Economics and Design II (3) Application of chemical engineering principles for the design of chemical processing equipment. Typical problems in the design of chemical plants. Not open to students who already have credit for ENCH 445. Prerequisite: ENCH 444.

ENCH 450 Chemical Process Development (3) Chemical process industries from the standpoint of technology, raw materials, products and processing equipment. Operations of major chemical processes and industries combined with quantitative analysis of process requirements and yields. Prerequisite: ENCH 427.

ENCH 452 Advanced Chemical Engineering Analysis (3) Application of digital and analog computers to chemical engineering problems. Numerical methods, programming, differential equations, curve fitting, amplifiers and analog circuits. Prerequisite: ENCH 427.

ENCH 453 Applied Mathematics in Chemical Engineering (3) Mathematical techniques applied to the analysis and solution of chemical engineering problems. Use of differentiation, integration, differential equations, partial differential equations and integral transforms. Application of infinite series, numerical and statistical methods. Prerequisite: ENCH 427.

ENCH 454 Chemical Process Analysis and Optimization (3) Applications of mathematical models to the analysis and optimization of chemical processes. Models based on transport, chemical kinetics and other chemical engineering principles will be employed. Emphasis on evaluation of process alternatives. Prerequisites: ENCH 427, 440.

ENCH 455 Chemical Process Laboratory (3) One lecture and six hours of laboratory per week. Experimental study of various chemical processes through laboratory and small semi-commercial scale equipment. Reaction kinetics, fluid mechanics, heat and mass transfer. Prerequisite: ENCH 427 and 440.

ENCH 461 Control of Air Pollution Sources (3) Theory and application of methods for the control and removal of airborne materials. Principles of design and performance of air quality control equipment. Prerequisite: Senior standing in engineering or consent of instructor.

ENCH 468 Research (1–3) Investigation of a research project under the direction of a faculty member. Comprehensive reports are required. Repeatable to a maximum of six credits.

ENCH 475 Electrochemical Engineering (3) Fundamentals of electrochemistry with application to engineering and commercial processes. Equilibrium potentials, reaction mechanisms, cell kinetics, polarization, surface phenomena. Electrorefining, electrowinning, oxidation and reduction, solid, liquid and gas systems. Aspects of design and performance of electroprocess plants.

ENCH 480 Engineering Analysis of Physiological Systems (3) Engineering description and analysis of physiological systems. Survey of bioengineering literature and an introduction to mathematical modeling of physiological systems.

ENCH 482 Biochemical Engineering (3) Introduction to biochemical and microbiological applications to commercial and engineering processes, including industrial fermentation, enzymology, ultrafiltration, food and pharmaceutical processing and resulting waste treatment. Enzyme kinetics, cell growth, energetics and mass transfer. Prerequisite, Senior standing in engineering or consent of instructor.

ENCH 485 Biochemical Engineering Laboratory (2) Techniques of measuring pertinent parameters in fermentation reactors, quantification of production variables for primary and secondary metabolites such as enzymes and antibiotics, the insolubilization of enzymes for reactors, and the demonstration of separation techniques such as ultrafiltration and affinity chromatography. Prerequisite or co-requisite: ENCH 482.

ENCH 490 Introduction to Polymer Science (3) The elements of the chemistry, physics, processing methods, and engineering applications of polymers. Prerequisite: ENCH 425.

ENCH 492 Applied Physical Chemistry of Polymers (3) Kinetics of formation of high polymers, determination of molecular weight and structure, and applied thermodynamics and phase equilibria of polymer solutions. Prerequisite: CHEM 481. Corequisite: CHEM 482 or consent of instructor.

ENCH 494 Polymer Technology Laboratory (3) One lecture and two laboratory periods per week. Measurement of mechanical, electrical, optical, thermal properties of polymers, measurement of molecular weight by viscosimetry isometric and light scattering methods. Application of X-ray, NMR, ESR, spectroscopy molecular relaxation, microscopy and electron microscopy to the determination of polymer structure, effects of ultraviolet light and high energy radiation. Prerequisite: ENCH 490 or 492.

ENCH 495 Rheology of Polymer Materials (3) Mechanical behavior with emphasis on the continuum point of view and its relationship to structural types. Elasticity, viscoelasticity, anelasticity and plasticity of single phase and multiphase materials. Students who have credit for ENCH 495 may not take ENMA 495 for credit. Prerequisite: ENCH 490 or 492.

ENCH 496 Processing of Polymer Materials (3) A comprehensive analysis of the operations carried out on polymeric materials to increase their utility. Conversion operations such as molding extrusion, bledding, film forming, and calendering. Development of engineering skills required to practice in the high polymer industry. Students who have credit for ENCH 496 may not take ENMA 496 for credit. Prerequisite: ENCH 490 or 492.

ENCH 609 Graduate Seminar (1)

ENCH 610 Chemical Engineering Thermodynamics (3) First semester. Advanced application of the general thermodynamic methods to chemical engineering problems. First and second law consequences; estimation and correlation of thermodynamic properties; phase and chemical reaction equilibria.

ENCH 620 Methods of Engineering Analysis (3) First semester. Application of selected mathematical techniques to the analysis and solution of engineering problems; included are the applications of matrices, vectors, tensors, differential equations, integral transforms, and probability methods to such problems as unsteady heat transfer, transient phenomena in mass transfer operations, stagewise processes, chemical reactors, process control, and nuclear reactor physics.

ENCH 630 Transport Phenomena (3) First semester. Heat, mass and momentum transfer theory from the viewpoint of the basic transport equations. Steady and unsteady state; laminar and turbulent flow; boundary layer theory, mechanics of turbulent transport; with specific application to complex chemical engineering situations.

ENCH 640 Advanced Chemical Reaction Kinetics (3) Second semester. The theory and application of chemical reaction kinetics to reactor design. Reaction rate theory; homogeneous batch and flow reactors; fundamentals of catalysis; design of heterogeneous flow reactors.

ENCH 648 Special Problems in Chemical Engineering (1–16)

ENCH 655 Radiation Engineering (3) Prerequisite: Permission of instructor. An analysis of such radiation applications as synthesizing chemicals, preserving foods, control of industrial processes. Design of irradiation installations, E.G., cobalt 60 gamma ray sources, electronuclear machine arrangement, and chemical reactors.

ENCH 656 Radiation Engineering (3) Prerequisite: Permission of instructor. An analysis of such radiation applications as synthesizing chemicals, preserving foods, control of industrial processes. Design of irradiation installations, E.G., cobalt 60 gamma ray sources, electronuclear machine arrangement, and chemical reactors.

ENCH 667 Radiation Effects Laboratory (3) radiation on the properties of matter for purposes other than those pointed toward nuclear power. Radiation processing, radiation-induced chemical reactions, and conversion of radiation energy; isotope power sources.

ENCH 670 Rheology of Engineering Materials (3) Prerequisite: ENMA 650. Mechanical behavior with

emphasis on the continuum point of view and its relationship to structural types. Elasticity, viscoelasticity, anelasticity and plasticity in single phase and multiphase materials.

ENCH 720 Process Analysis and Simulation (3) Second semester. Prerequisite: ENCH 630. Development of mathematical models of chemical processes based on transport phenomena, chemical kinetics, and other chemical engineering methods. Emphasis on principles of model building and simulation utilizing mathematical solutions and computer methods.

ENCH 723 Process Engineering and Design (3) First and second semesters. Coordination of chemical engineering and economics to advanced process engineering and design. Optimization of investment and operating costs. Solution of typical problems encountered in the design of chemical engineering plants.

ENCH 730 Complex Equilibrium Stage Processes (3) Second semester. The theory and application of complex equilibrium stages. Binary and multicomponent absorption; extraction; liquefaction.

ENCH 735 Chemical Process Dynamics (3) First semester. Prequisites: Differential equations or consent of instructor. Analysis of open and closed control loops and their elements; dynamic response of processes; choice of variables and linkages; dynamic testing and synthesis; noise and drift; chemical process systems analysis; strategies for optimum operation.

ENCH 737 Chemical Process Optimization (3) Second semester. Techniques of modern optimization theory as applied to chemical engineering problems. Optimization of single and multivariable systems with and without constraints. Application of partial optimization techniques to complex chemical engineering processes.

ENCH 761 Enzyme Engineering (3) Prerequisite: ENCH 640. Enzyme science and kinetics; principles of enzyme insolublization and denaturation with application to design, operation and modeling of enzyme reactors. The relationship between mass transfer and apparent kinetics in enzyme systems; and techniques of separation and purification of enzymes.

ENCH 762 Advanced Biochemical Engineering (3) Prerequisite: ENCH 482 or permission of instructor. Advanced topics to include use of a digital computer for mathematical modeling of the dynamics of biological systems; separation techniques for heat sensitive biologically active materials; and transport phenomena in biological systems.

ENCH 763 Engineering of Artificial Organs (3) Prerequisite: ENCH 480 or permission of instructor. Design concepts and engineering analysis of devices to supplement or replace natural functions; artificial kidney; heart assistor; membrane oxygenator; materials problems, physiological considerations.

ENCH 784 Polymer Physics (3) Prerequisite: ENCH 490 or consent of instructor. Application and correlation of mechanical and dielectric relaxation, NMR, electron microscopy, X-ray diffraction, diffusion and electrical properties to the mechanical properties and structure of polymers in the solid state.

ENCH 786 Polymer Processing and Applications (3) Prerequisite: ENCH 490 or consent of instructor. Application of theoretical knowledge of polymers to industrial processes. An analysis of polymerization, stabilization, electrical, rheological, thermal, mechanical and optical properties and their influence on processing conditions and end use applications.

ENCH 799 Master's Thesis Research (1–6)

ENCH 818 Advanced Topics in Thermodynamics (3) Second semester. Prerequisite: CHEM 604.

ENCH 828 Advanced Topics in Chemical Reaction Systems (3) First semester. Offered in alternate years. Prerequisite: ENCH 640.

ENCH 838 Advanced Topics in Transfer Theory (3) First semester. Offered in alternate years. Prerequisite: ENCH 720.

ENCH 848 Advanced Topics in Separation Processes (3) Second semester. Offered in alternate years.

ENCH 899 Doctoral Dissertation Research (1–8)

Chemical Physics Program

Acting Director: Sengers.
Associate Director: Alexander.
(CHEM) *Professors:* Alexander, McNesby, Moore.
Associate Professors: Greer, Khanna, Miller, Murphy, Tossell, Weiner.
(ENCH/IPST) *Professor:* Gentry.
(ENEE) *Professors:* Hochuli, Lee.
Associate Professor: Davis.
(IPST) *Professors:* Benesch, Ginter, Montroll, Sengers, Wilkerson, Zwanzig.
Associate Professors: Coplan, Gammon, McIlrath.
(METO) *Associate Professor:* Ellingson.
Assistant Professor: Pitter.
(PHYS) *Associate Professors:* Lynn, Redish.
(PHYS/IPST) *Professors:* Dorfman, Ferrell.

The Chemical Physics Program provides an academic path for those candidates wishing to establish a professional career for which knowledge of both physics and chemistry is desirable. The program offers M.S. and Ph.D. degrees in chemical physics. Candidates have the option of concentrating their studies in chemistry, physics, chemical engineering, electrical engineering or meteorology.

The Chemical Physics Program is under the joint sponsorship of the Institute for Physical Science and Technology, the Chemistry Department, the Department of Physics and Astronomy and the College of Engineering. The Chemical Physics Committee oversees the program. The Committee consists of faculty representatives of the sponsoring units, and has the director of the Chemical Physics Program as its chairman. The Chemical Physics Program Office which is affiliated with the Institute for Physical Science and Technology administers the program.

About 30 faculty members at the College Park campus, active in subject areas related to chemical physics, are affiliated with the Chemical Physics Program. The areas of study cover a very broad range of subjects. Examples are: atomic and molecular science including atomic and molecular structure and spectroscopy, laser physics and quantum electronics, atmospheric physics and spectroscopy, statistical physics, thermodynamics and phase transitions, physics and chemistry of gases and condensed matter. Some of the research activities are related to similar activities in several government laboratories in the Washington metropolitan area. A booklet describing the scope of chemical physics at the College Park campus can be obtained from the Chemical Physics Program Office upon request.

Admission and Degree Information

Students with an undergraduate major in physics, chemistry, engineering or mathematics may apply. However, for a successful completion of the chemical physics study a strong background in physics and some background in chemistry is desirable. Students admitted to the Chemical Physics Program will also be listed as graduate students in the department of their chosen area of concentration; however, all matters concerning the course of study will be handled by the Chemical Physics Program Committee and the Chemical Physics Program Office.

The course program will be adjusted to the needs of the individual student. In case the candidate does not possess the required undergraduate background in both physics and chemistry, the candidate's advisory committee will prescribe appropriate undergraduate courses. Candidates for the Ph.D. degree are required to pass the chemical physics qualifying examination which is based on material covered by the physics qualifying examination in the areas of classical mechanics, quantum mechanics, statistical mechanics, thermodynamics, electricity and magnetism. Additional questions cover areas specifically appropriate to chemical physics, namely atomic and molecular spectroscopy and structure, molecular bonding theory, chemical reaction dynamics and chemical thermodynamics and statistical mechanics. In addition to successfully passing the qualifying examination, the student will be required to take a graduate laboratory course, 3 semesters of seminar, 4 advanced courses and 12 credit hours of thesis research concluded by the presentation and defense of an original dissertation. Under certain circumstances graduate students can have access to the resources available at government laboratories in the Washington metropolitan area.

Candidates for the M.S. degree may choose between a thesis or non-thesis option. Programs of work are arranged on an individual basis and require approval of an advisor associated with the chemical physics program. The requirements for the non-thesis option are completion of 30 credit hours of courses including PHYS 602, PHYS 622, CHEM 601 and a graduate laboratory course, unless specifically exempted, submitting a scholarly paper and passing a written examination. The requirements for the thesis option are completion of 24 credit hours of courses including PHYS 602, PHYS 622, CHEM 601 and a graduate laboratory, unless specifically exempted, 6 credit hours of thesis research, a written thesis and a passing grade on an oral examination which includes the defense of the written thesis.

Financial Assistance

Teaching and research assistantships are available for qualified students.

Additional Information

Requests for further information concerning the Chemical Physics Program can be obtained by writing to Professor J. V. Sengers, Acting Director, Chemical Physics Program, Institute for Physical Science and Technology, University of Maryland, College Park.

Chemistry Program

Professor and Chairman: McNesby
Professors: Adler, Alexander, Ammon, Bellama, Castellan, Fraser-Reid, Freeman, Goldsby, Gordon, Grim, Henery-Logan, Holmlund, Huheey, Jaquith, Jarvis, Keeney, Mariano, Mazzocchi, Moore, Munn, O'Haver, Ponnamperuma, Stewart, Viola, Walters, Zoller.
Associate Professors: Boyd, Campagnoni, DeVoe, Gokel, Greer, Hansen, Heikkinen, Helz, Kasler, Khanna, Lakshmanan, Miller, Murphy, Sampugna, Tossell, Weiner
Assistant Professors: Cheng, Dunaway-Mariano, McArdle, Mignerey, Schuda
Research Professor: Bailey

The Chemistry Department offers programs leading to the Master of Science or Doctor of Philosophy degrees with specialization in the fields of analytical chemistry, biochemistry, chemical physics (in cooperation with the Institute of Physical Sciences & Technology and the Department of Physics and Astronomy),

environmental chemistry, geochemistry, inorganic chemistry, nuclear chemistry, organic chemistry, and physical chemistry. The graduate program in biochemistry is described separately in this catalog. The graduate program in chemistry has been designed with maximum flexibility so that a student can achieve a strong background in his chosen field of specialization.

Admission and Degree Information

Both the thesis and non-thesis options are offered for the M.S. degree. Departmental regulations concerning diagnostic examinations, comprehensive examinations, and other matters pertaining to course work have been assembled for the guidance of candidates for graduate degrees. Copies of these regulations are available from the Department of Chemistry.

Facilities and Special Resources

The Department has many special research facilities to support research in the fields given above. The new research wing of the chemistry building houses biochemistry research, a centralized animal colony, and some of the inorganic and analytical chemical research. Nuclear chemistry facilities include the 140–MeV cyclotron housed in the Physics Department. Other facilities include "clean" rooms for lunar and environmental sample analysis, an electron microscope, X-ray fluorescence instrumentation, an electron microprobe, mass spectrometers, NMR spectrometers including 100 MHz and 200 MHz Fourier-transform NMR spectrometers, ultracentrifuges, and analytical optical spectrometers. Departmental research is supported on two large computers in the Computer Science Building, a UNIVAC 1100/41 and a UNIVAC 1108, both of which are accessible by remote time-sharing terminals. A variety of facilities including a laser laboratory, other electron microscopes, and an ESCA spectrometer are available through the Center of Materials Research on campus. The Department has an excellent glassblowing shop, a fine student faculty machine shop, and access to other campus machine shops. The Chemistry Library, located in the new research wing, has an extensive collection of books, journals, and abstracts in chemistry, biochemistry and allied fields. Included in the Chemistry Library is a computer terminal for literature searching.

Financial Assistance

Entering graduate students are normally supported on graduate teaching assistantships. Their assistantships usually involve teaching undergraduate laboratory and recitation classes and enable the student to pursue a ten-credit program of graduate study each semester.

Additional Information

The Department has a brochure available describing its graduate program and the research interests of its faculty. For a copy of the brochure, or for specific information on graduate programs in chemistry, admissions procedures, or financial aid, contact Dr. Paul Mazzochi, Associate Chairman for Graduate Studies and Research, Department of Chemistry.

Courses

CHEM 401 Inorganic Chemistry 3 Prerequisite: CHEM 481.

CHEM 403 Radiochemistry Prerequisite: One year of college chemistry and one year of college physics. Radioactive decay; introduction to properties of atomic nuclei; nuclear processes in cosmology; chemical, biomedical and environmental applications of radioactivity; nuclear processes as chemical tools; interaction of radiation with matter **(3)**

CHEM 421 Advanced Quantitative Analysis (3) Prerequisites: CHEM 430 and 482 or concurrent registration. An examination of some advanced topics in quantitative analysis including nonaqueous titrations, precipitation phenomena, complex equilibria, and the analytical chemistry of the less familiar elements.

CHEM 423 Organic Quantitative Analysis (3) Prerequisite: CHEM 203–204 or 213–214, and consent of the instructor. Two three-hour laboratory periods per week. The semi-micro determination of carbon, hydrogen, nitrogen, halogen and certain functional groups.

CHEM 430 Chemical Measurements Laboratory I (3) One lecture and two three-hour laboratory periods per week. Corequisite, CHEM 481. An introduction to the principles and applications of quantitative techniques useful in chemistry, with emphasis on modern instrumentation. Computer programming, electronic circuits, spectroscopy, chemical separations.

CHEM 431 Chemical Measurements Laboratory II (3) One lecture and two three-hour laboratory periods per week. Prerequisite: CHEM 481; Corequisite: CHEM 482. An introduction to the principles and applications of quantitative techniques useful in chemistry, with emphasis on modern instrumentation. Communications techniques, vacuum systems, thermochemistry, phase equilibria, chemical kinetics, electrochemistry

CHEM 433 Chemical Synthesis (3) One lecture and two three-hour laboratory periods per week. Prerequisite: CHEM 201–202 or 211–212, and 203–204 or 213–214

CHEM 441 Advanced Organic Chemistry (3) Prerequisite: CHEM 481. An advanced study of the compounds of carbon, with special emphasis on molecular orbital theory and organic reaction mechanisms.

CHEM 443 Qualitative Organic Analysis (3) One lecture and two-three hour laboratory periods per week. Prerequisite: CHEM 201–202 or 211–212, and 203–204 or 213–214. The systematic identification of organic compounds.

CHEM 473 Geochemistry of Solids (3) Prerequisite: CHEM 482 or GEOL 422. Principles of crystal chemistry applied to structures, properties and reactions of minerals and non-metallic solids. Emphasis is placed on the relation of structural stability to bonding, ionic size, charge, order-disorder, polymorphism, and isomorphism.

CHEM 474 Environmental Chemistry (3) Prerequisite: CHEM 481, or equivalent. The sources of various elements and chemical reactions between them in the atmosphere and hydrosphere are treated. Causes and biological effects of air and water pollution by certain elements are discussed.

CHEM 481 Physical Chemistry I (3) Three lectures per week. Prerequisite: CHEM 203–204 or 213–214, MATH 141, PHYS 142 or PHYS 263 (PHYS 263 may be taken concurrently with CHEM 481) or consent of instructor. A course primarily for chemists and chemical engineers.

CHEM 482 Physical Chemistry II (3) Three lectures per week. Prerequisite, CHEM 481, or consent of instructor. A course primarily for chemists and chemical engineers.

CHEM 485 Advanced Physical Chemistry (2) Quantum chemistry and other selected topics.

CHEM 485 Advanced Physical Chemistry (2) Prerequisite: CHEM 482. Quantum Chemistry and other selected topics.

CHEM 486 Advanced Physical Chemistry Laboratory (2) Two three-hour laboratory periods per week. Prerequisites: ChEM 482 and consent of instructor.

CHEM 498 Special Topics in Chemistry (3) Three lectures or two lectures and one three-hour laboratory per week. Prerequisite varies with the nature of the topic being considered. Course may be repeated for credit if the subject matter is substantially different, but not more than three credits may be accepted in satisfaction of major supporting area requirements for chemistry majors.

CHEM 601 Advanced Inorganic Chemistry I (3) Prerequisite: CHEM 401 or equivalent. Three lectures per week. A survey of the fundamentals of modern inorganic chemistry which serves as a basis for more advanced work

CHEM 602 Advanced Inorganic Chemistry II (3) Prerequisite: CHEM 601 Three lectures per week A continuation of CHEM 601 with more emphasis on current work in inorganic chemistry

CHEM 603 Advanced Inorganic Laboratory (3) Prerequisite: CHEM 601 or concurrent registration therein One lecture and two three-hour laboratories per week. Practice in synthesis and modern experimental techniques in inorganic chemistry.

CHEM 605 Chemistry of Coordination Compounds (3) Prerequisite: CHEM 601 or consent of instructor. Three lectures per week. Structure and properties of coordination compounds and the theoretical bases on which these are interpreted.

CHEM 606 Chemistry of Organometallic Compounds (3) Prerequisite: CHEM 601 or consent of instructor. Three lectures per week. An in-depth treatment of the properties of compounds having metal-carbon bonds.

CHEM 608 Selected Topics in Inorganic Chemistry (1–3) Prerequisite: CHEM 601 and 602, or equivalent One to three lectures per week. Topics of special interest and current importance. Course may be repeated to a maximum of six credits if topics are different.

CHEM 621 Chemical Microscopy I (2) One lecture and one three hour laboratory period per week. Registration limited. Prerequisite: Consent of instructor. A study of the use of the microscope in chemistry

CHEM 622 Chemical Microscopy II (2) One lecture and one three hour laboratory period per week. Prerequisite: CHEM 621. A study of the topical properties of crystals.

CHEM 623 Optical Methods of Quantitative Analysis (3) Two lectures and one three-hour laboratory per week. Prerequisites: CHEM 421 and 482. The quantitative applications of emission spectroscopy, atomic absorption spectroscopy, ultraviolet, visible, and infrared spectrophotometry, fluorescence, atomic fluorescence, nephelometry, and of certain closely related subjects like NMR and mass spectroscopy

CHEM 624 Electrical Methods of Quantitative Analysis (3) Two lectures and one three-hour laboratory per week. Prerequisites: CHEM 421 and 482. The use of conductivity, potentiometry, polarography, voltammetry, amperometry, coulometry, chronopotentiometry in quantitative analysis.

CHEM 625 Separation Methods in Quantitative Analysis (3) Two lectures and one three-hour laboratory per week. Prerequisites: CHEM 421 and 482. The theory and practical application to quantitative analysis of the various forms of chromatography, ion exchange, solvent extraction, and distillation.

CHEM 628 Modern Trends in Analytical Chemistry (2) Two lectures per week. Prerequisites: CHEM 421 and 482. A study of advanced methods, including topics such as statistical treatment of analytical data, kinetic methods in analytical chemistry, analytical measurements based on radioactivity, and enzymatic techniques.

CHEM 641 Organic Reaction Mechanisms (3)

CHEM 642 Physical Organic Chemistry (3)

CHEM 643 Organic Chemistry of High Polymers (2) An advanced course covering the synthesis of monomers, mechanisms of polymerization, and the correlation between structure and properties in high polymers.

CHEM 644 Molecular Orbital Theory (2) A partial quantitative application of molecular orbital theory and symmetry to the chemical properties and reactions of organic molecules. Prerequisites. CHEM 441 and 482.

CHEM 645 The Chemistry of the Steroids (2)

CHEM 646 The Heterocyclics (2)

CHEM 648 Special Topics in Organic Chemistry (1–3) One to three lecture hours per week. Topics of special interest and current importance. Course may be repeated to a maximum of nine credits provided the topics are different.

CHEM 664 The Chemistry of Natural Products (2) Prerequisite: CHEM 441 The chemistry and physiolog-

ical action of natural products. Methods of isolation, determination of structure and synthesis.

CHEM 678 Special Topics in Environmental Chemistry (3) Prerequisite: CHEM 474. In-depth treatment of environmental chemistry problem areas of current research interest. The topics will vary somewhat from year to year. Repeatable to maximum of 6 credits. Provided subject is different.

CHEM 681 Infra-Red and Raman Spectroscopy (2) Prerequisite: Consent of instructor.

CHEM 682 Reaction Kinetics (3)

CHEM 683 Electrochemistry (3) Prerequisite: CHEM 684 or equivalent.

CHEM 684 Chemical Thermodynamics (3) Prerequisite: CHEM 482 or equivalent.

CHEM 685 Molecular Structure (3)

CHEM 686 Chemical Crystallography (3) Prerequisite: Consent of instructor. A detailed treatment of single-crystal x-ray methods.

CHEM 687 Statistical Mechanics and Chemistry (3) Prerequisite: CHEM 684 or equivalent.

CHEM 688 Selected Topics in Physical Chemistry (2)

CHEM 689 Special Topics in Physical Chemistry (3)

CHEM 690 Quantum Chemistry I (3) Prerequisite: CHEM 485.

CHEM 691 Quantum Chemistry II (3) Prerequisite: CHEM 690 or PHYS 622.

CHEM 699 Special Problems in Chemistry (1–6) Prerequisite: One semester of graduate study in chemistry. Laboratory experience in a research environment. Restricted to students in the non-thesis M.S. option. Repeatable for a maximum of 6 credits.

CHEM 702 Radiochemistry Laboratory (1–2) One or two four-hour laboratory periods per week. Registration limited Prerequisites: CHEM 403 (or concurrent registration therein), and consent of instructor.

CHEM 703 Advanced Radiochemistry (2) Prerequisite: CHEM 403 and BCHM 462. Utilization of radioisotopes with special emphasis on applications to problems in the life sciences.

CHEM 704 Advanced Radiochemistry Laboratory (1–2) One or two four-hour laboratory periods per week. Prerequisite: CHEM 702 and consent of instructor. Laboratory training in the utilization of radioisotopes with special emphasis on applications to problems in the life sciences.

CHEM 705 Nuclear Chemistry (3) Nuclear structure models, radioactive decay processes, nuclear reactions in complex nuclei, fission, nucleosynthesis and nuclear particle accelerators.

CHEM 718 Special Topics in Nuclear Chemistry (1–3) One to three lectures per week. A discussion of current research problems. Subtitles will be given at each offering. Repeatable for credit to a maximum of six hours.

CHEM 721 Organic Geochemistry (3) Prerequisite: CHEM 201 or equivalent. A discussion of the fate of natural organic products in the geological environment. The influence of diagenetic factors, such as hydrolysis, heat, pressure, etc., on such compounds as cellulose, lignin, proteins, and lipids, detailed consideration of the origin of soil organic matter, carbonaceous shales, coal, and crude oil.

CHEM 722 Cosmochemistry (3) Prerequisite: CHEM 482 or equivalent. Current theories of origin and evolution of the solar system with emphasis on the experimental data available to chemists from examination of meteorites, the moon, and the earth.

CHEM 723 Marine Geochemistry (3) Prerequisite: CHEM 481 or equivalent. The geochemical evolution of the ocean; composition of sea water, density-chlorinity-salinity relationship and carbon dioxide system. The geochemistry of sedimentation with emphasis on the chemical stability and inorganic and biological production of carbonate, silicate and phosphate containing minerals.

CHEM 727 Geochemical Differentiation (3) Distribution of the chemical elements in the earth and the mechanisms by which the distributions came about.

CHEM 728 Selected Topics in Analytical Geochemistry (2–3) One or two lectures per week and one laboratory per week. Prerequisite: Consent of instructor. This course will be subtitled each time it is offered to indicate the analytical method discussed. Repeatable for credit to a maximum of nine hours. Enrollment will be limited.

CHEM 729 Special Topics in Geochemistry (1–3) One to three lectures per week. A discussion of current research problems. Subtitles will be given at each offering. Repeatable for credit to a maximum of six hours.

CHEM 750 Chemical Evolution (3) Prerequisite: CHEM 441 or 721; BCHM 462 or ZOOL 446; or BOTN 616; or consent of instructor. The chemical processes leading to the appearances of life on earth. Theoretical and experimental considerations related to the geochemical, organic, and biochemical phenomena of chemical evolution.

CHEM 799 Master's Thesis Research (1–6)

CHEM 898 Seminar (1)

CHEM 899 Doctoral Dissertation Research (1–8)

Civil Engineering Program

Professor and Chairman: Ragan
Professors: Birkner, Carter, Colville, Heins, McCuen, Sternberg, Witczak
Associate Professors: Aggour, Garber, Piper, Schelling, Vannoy
Assistant Professors: Alleman, Kavanagh, Saklas, Schonfeld, Schwartz

The Department of Civil Engineering offers graduate work leading to the degrees of Master of Science and Doctor of Philosophy. All programs are planned on an individual basis by the student and his advisor to consider the student's background and special interests. Courses and research opportunities are available in the general areas of transportation and urban systems, environmental engineering and water resources, structural engineering, and geotechnical engineering. In general, emphasis is on learning sound engineering principles and applying them, to provide for the needs of man.

Admission and Degree Information

Applicants for admission should hold a B.S. degree in Civil Engineering. However, applicants with undergraduate degrees in other disciplines may be accepted with the stipulation that deficiencies in prerequisite undergraduate course work be corrected before enrolling in graduate courses. There are no entrance examinations required for the program.

Two options are available for the Master of Science degree: thesis and non-thesis. The Department's policies and requirements are the same as the requirements of the Graduate School.

The requirements for the Doctor of Philosophy degree are the same as those imposed by the Graduate School. An individual program of study to suit the needs of the student is developed by the student and his advisor. The equivalent of two years of full-time study beyond the Master of Science degree is the minimum requirement. The student must pass a qualifying examination before being admitted to candidacy. Normally, the qualifying exam is taken one year after the completion of the M.S. degree. There is no language requirement for the Ph.D. degree.

Facilities and Special Resources

The research facilities of the Department are available to graduate students. These include laboratories in the following areas: transportation, systems analysis, environmental, hydraulics, structures, remote sensing, and soil mechanics. A UNIVAC 1106 and a UNIVAC 1108, complemented by remote access units located in the Department and engineering building, are available.

The Washington and Baltimore Metropolitan Areas are easily accessible for data, field studies, library access, contacts with national organizations and attendance at national meetings. The location of the University of Maryland offers a unique opportunity to obtain an advanced degree in Civil Engineering.

Financial Assistance

Almost all full-time graduate students receive financial assistance. Inquiries about financial assistance and program information should be directed to the Director of Graduate Studies, Department of Civil Engineering.

Courses

ENCE 410 Advanced Strength of Materials (3) Prerequisites: ENES 220, ENCE 350 and MATH 246. Strength and deformation of deformable bodies, plane stress and strain. Torsion theory, unsymmetical bending, curved beams. Behavior of beams, columns, slabs, plates and composite members under load. Elastic and inelastic stability.

ENCE 411 Experimental Stress Analysis (4) Three lectures and one laboratory per week. Prerequisite: ENES 220. Application of experimental data on materials to design problems. Correlation of analytical and experimental methods of analysis with design. Electric strain gages, photoelasticity, brittle laquer methods and various analogies.

ENCE 420 Basic Civil Engineering Planning I (3) Prerequisite: Senior standing or consent of the instructor. Urban-regional physical planning from the civil engineering viewpoint. Integration of the planning aspects of engineering, environmental, structural, transportation and water resources into a systems approach to the practice of civil engineering. Also included: site, construction, and engineering materials planning; engineering economics and evaluation; current topics.

ENCE 421 Construction Engineering (3) Two lectures and one laboratory per week. Prerequisites: ENCE 340, 351, 370 or consent of instructor. The ordering of engineered construction. Modern techniques of construction planning, estimating, scheduling, operation, control. Construction methods. Contract and resource management. Systems approach to construction management practice.

ENCE 430 Hydraulic Engineering and Open Channel Flow (4) Three lectures and one laboratory per week. Prerequisite: ENCE 330. Application of basic principles to the solution of engineering problems: ideal fluid flow, mechanics of fluid resistance, open channel flow under uniform, gradually varied and rapidly varied conditions, sediment transport, role of model studies in analysis and design.

ENCE 431 Surface Water Hydrology (3) Prerequisites: ENCE 330 and 360. Study of the physical processes of the hydrologic cycle. Hydrometeorology, concepts of weather modification, evaporation and transpiration infiltration studies, runoff computations, flood routing, reservoir requirements, emphasis on process simulation as a tool in water resource development.

ENCE 432 Ground Water Hydrology (3) Prerequisites: ENCE 330. Concepts related to the development of the ground water resource, hydrogeology, hydrodynamics of flow through porous media, hydraulics of wells, artificial recharge, sea water intrusion, basin-wide ground water development.

ENCE 433 Environmental Engineering Analysis (3) Two lectures and one laboratory per week. The theory and analytical techniques used in evaluating man's environment. Emphasis is given to the areas of quantitative, physical, electroanalytical and organic chemistry as applied to chemical analysis of water.

ENCE 434 Air Pollution (3) Classification of atmospheric pollutants and their effects on visibility,

inanimate and animate receptors. Evaluation of source emissions and principles of air pollution control; meteorological factors governing the distribution and removal of air pollutants; air quality measurements and air pollution control legislation.

ENCE 435 Sanitary Engineering Analysis and Design (4) Three lectures and one laboratory per week. Prerequisite: ENCE 221 and ENCE 330. The application of sanitary analysis and fundamental principles to the design and operation of water and waste water treatment plants and the control of stream pollution.

ENCE 440 Engineering Soil Tests (4) Two lectures and two laboratory sessions per week. Prerequisite: ENCE 340 or equivalent. Critical review of major soil tests and their interpretation for engineering purposes. Engineering classification tests (Atterberg limits, grain-size distribution, specific gravity), permeability and seepage properties, in-situ and lab density-moisture tests, soil strength (penetrometers, vane shear, CBR, unconfined compression, direct shear and triaxial) and compressibility characteristics.

ENCE 441 Soil-Foundation Systems (3) Prerequisite-ENCE 340 or equivalent. Critical review of classical lateral earth pressure theories, analysis of braced excavation systems, cantilever and anchored sheet piling design, bearing capacity of shallow foundations (footings and mats) design of deep pile foundations to include pile capacity and pile group action, and seismic effects upon foundations are treated.

ENCE 442 Highway and Airfield Pavement Design (3) Prerequisite: ENCE 340 or equivalent. Principles relative to the design, construction and rehabilitation of highway and airfield pavement systems. Introduction to multi-layered elastic and slab theories, properties of pavement materials and methods of characterization, stochastic treatment of design variables, economic principles of design alternates and the effect of environment upon pavement performance. A critical review of existing rigid and flexible design methods as well as major fundamentals relative to the rehabilitation of existing pavement systems.

ENCE 450 Design of Steel Structures (3) Prerequisites: ENCE 350 and pre- or corequisite registration in ENCE 360. Analyses for stresses and deflections in structures by methods of consistent deformations, virtual work and internal strain energy. Application to design of plate girders, indeterminate and continuous trusses, two hinged arches and other structures. Elements of plastic analysis and design of steel structures.

ENCE 451 Design of Concrete Structures (4) Prerequisites: ENCE 351 and pre- or corequisite ENCE 360. Three lecture hours and one laboratory per week. Design of reinforced concrete structures, including slabs, footings, composite members, building frames, and retaining walls. Approximate methods of analysis; code requirements; influence of concrete properties on strength and deflection; optimum design. Introduction to prestressed concrete design.

ENCE 460 Modern Techniques for Structural Analysis (3) Prerequisite: ENCE 360 and pre- or corequisite: ENCE 351. Two lecture hours and one laboratory per week. Application of computer-oriented methods and numerical techniques to analysis and design of structural systems. Matrix formulation of the stiffness and flexibility methods for framed structures. Introduction of numerical techniques to the solution of selected problems in such topics as plates, structural stability, and vibrations.

ENCE 461 Analysis of Civil Engineering Systems I (3) Prerequisite: Senior standing or consent of instructor. Application of the principles of engineering economy and statistics to the solution of civil engineering problems. Economic comparison of alternatives using present worth, annual cost, rate of return and cost benefit analyses. Development and use of simple and multiple regression models, and statistical decision theory.

ENCE 463 Engineering Economics and System Analysis (3) Prerequisite: Senior standing in engineering, or consent of instructor. Development and application of the principles of engineering economics to problems in civil engineering. Evaluation of design alternatives, depreciation and sensitivity analysis. Use of systems analysis techniques, including CPM, pert and decision networks.

ENCE 470 Highway Engineering (4) Three lectures and one three-hour laboratory per week. Prerequisite: ENCE 340. Location, design, construction and maintenance of roads and pavements. Introduction to traffic engineering.

ENCE 473 Air and Water Transportation Engineering (3) Prerequisite: ENCE 370. Detailed study of the planning, design, construction, operations and maintenance of airports and waterways, emphasis on design and operations of transportation facilities.

ENCE 474 Railroad Mass Transportation Engineering (3) Prerequisite: ENCE 370. Detailed study of the planning, design, construction, operations, and maintenance of railroads and mass transportation systems, emphasis on design and operations of transportation facilities.

ENCE 489 Special Problems (3) Prerequisite: Senior standing. A course arranged to meet the needs of exceptionally well prepared students for study in a particular field of civil engineering.

ENCE 600 Advanced Engineering Materials Laboratory (3) Prerequisites: ENES 220, 221 and ENCE 300 or equivalent. Critical examination of the methods for testing engineering materials and structures under static, repeated, sustained and impact forces. Laboratory experiments for the determination of strength and stiffness of structural alloys, concrete and other construction materials. Critical examination of the effects of test factors on the determination of engineering properties.

ENCE 601 Structural Materials and Design (3) Prerequisite: ENCE 410 and 411 or consent of instructor. Relation of structural analysis, properties of materials and laboratory study of the behavior of members to structural design methods, codes and specifications. Effects of temperature, loading rates and state of combined stress on behavior of construction materials.

ENCE 603 Theories of Concrete and Granular Materials (3) Prerequisites: ENCE 600, or consent of instructor. Critical reviews of analytical and experimental investigations of the behavior of concretes under diverse conditions of loading and environment. Mechanics of granular aggregates and the chemistry of cements. Theories of the design of portland cement and field experience.

ENCE 610 Advanced Strength of Materials (3) Prerequisites: ENES 220, 221 and ENCE 300, or equivalent. Analysis for stress and deformation in engineering members by the methods of mechanics of materials and elementary theories of elasticity and plasticity. Problems in flexure, torison plates and shells, stress concentrations, indeterminate combinations, residual stresses, stability.

ENCE 612 Structures Research Methods and Model Analysis (3) Prerequisite: ENCE 450 and ENCE 451 or equivalent. Instrumentation, data analysis; states of stress; structural models, structural similitude; analogies; non-destructive testing techniques; planning research projects, lab studies and reports.

ENCE 620 Urban-Regional Civil Engineering Planning (3) First semester. Prerequisite: Degree in civil engineering or consent instructor. Theory and methodology for the synthesis of general civil engineering aspects of urban and regional planning. Integration of land use conditions and capabilities, population factors and needs, engineering economics and engineering technologies. Application to special problems in urban-regional development. Preparation of engineering reports. Presentation methods.

ENCE 621 Civil Engineering Planning (3) Second semester. Prerequisite: ENCE 620 or equivalent. General to comprehensive planning of complex engineering facilities such as industrial plants, bridges, utilities and transportation projects. Planning based on the synthesis of all applicable factors. Emphasis on general civil engineering planning including site, structural and construction planning. Plan evaluation and feasibility.

ENCE 622 Urban and Regional Systems Analysis (3) Prerequisite or corequisite: ENCE 461 or consent of instructor. Current applications and research approaches in land-use forecasting, land-use evaluation, urban transportation, land-use interrelationships, and the planning implementation process in a systems analytic framework.

ENCE 630 Analysis and Design of Water Resource Systems (3) Prerequisite: ENCE 461 or equivalent Use of advanced techniques for the design and analysis of complex, multi-purpose water resource systems, identification of the objectives of design and translation of the objectives into design criteria; evaluation of alternate designs and the selection of the best design; special emphasis on optimization and simulation techniques which are applicable to water resource systems.

ENCE 631 Advanced Hydrologic Analysis (3) Emphasis is on the analysis of hydrologic data for the development of information necessary for design or for the identification of important processes; eigenvalue and eigenvector analysis of linear hydrologic systems; application of multivariant statistical methods; non-linear least squares.

ENCE 632 Free Surface Flow (3) Prerequisite: ENCE 330 or equivalent. Application of fundamentals of fluid mechanics to problems of free surface flow; computation of steady and transient water surface profiles; stratified flows in reservoirs and estuaries; diffusion; transition structures; sediment transport.

ENCE 633 The Chemistry of Natural Waters (4) Prerequisite: ENCE 433 or consent of instructor. Three lectures, one lab a week. Application of principles from chemical thermodynamics and kinetics to the study and interpretation of the chemical characteristics of natural water systems. The chemical composition of natural waters is rationalized by considering metal ion solubility controls, Ph, carbonate equilibria, absorption reactions, redox reactions, and the kinetics of oxygenation reactions which occur in natural water environments.

ENCE 634 Air Sampling and Analysis (3) Prerequisite: ENCE 434 or consent of instructor. Two lectures and one laboratory a week. The theory and techniques used in the determination and measurement of chemical, radiological, and biological pollutants in the atmosphere. Discussion of air sampling equipment, analytical methods and data evaluation.

ENCE 635 Design of Water Purification Facilities (3) Corequisite: ENCE 636 or equivalent. One lecture and two laboratory periods a week. Application of basic science and engineering science to design of water supply and purification processes; design and economics of unit operations as applied to environmental systems.

ENCE 636 Unit Operations of Environmental Engineering (3) Prerequsite: ENCE 221 or consent of instructor. Properties and quality criteria of drinking water as related to health are interpretated by a chemical and biological approach. Legal aspects of water use and handling are considered. Theory and application of aeration, sedimentation, filtration, centrifugation, desalinization, corrosion and corrosion control are among topics to be considered.

ENCE 637 Biological Principles of Environmental Engineering (4) Prerequisite: MICB 440 or equivalent. Three lectures and one lab period a week. An exposition of biological principles directly affecting man and his environment; assay, control and treatment of biological and virological agents in water, sewage, and air; microbiology and biochemistry of aerobic and anerobic treatment processes for aqueous wastes.

ENCE 640 Advanced Soil Mechanics (3) Prerequisites: ENCE 340 or equivalent. Introduction to the use of elastic theory in stress and displacement solutions to geotechnical engineering (soil and rock mechanics). The effect of soil moisture (at rest) relative to effective stress principles, capillary and frost. Exact and numeric techniques for the analysis for soil seepage under isotropic and anisotropic conditions. Classical settlement (consolidation) and compressibility theories, including finite difference solution for vertical and radial drainage.

ENCE 641 Advanced Foundations (3) Prerequisite: ENCE 340 or equivalent. Introduction to braced lateral earth pressure concepts and theories applied to foundations. Analysis of braced excavations, retaining walls and design of cantilever and anchored sheet piling systems. Principles of Cofferdam design; bearing capacity theories related to shallow and deep foundations; soil-foundation interactions for footing and mat designs and analysis of single pile and pile group foundations. Exact and numeric solution techniques.

ENCE 642 Soil Dynamics (3) Pre- or corequisite: ENCE 640 or consent of instructor. Introduction to field and laboratory methods for determining the dynamic characterization of soil at both small and large strain levels. Analysis and design of soil foundations subjected to machinery generated vibrations. A critical review of earthquake causes and their effect upon

foundations and earth structures relative to earthquake resistant design methodologies.

ENCE 643 Stability of Earth Structures (3) Prerequisite: ENCE 340 or equivalent. Shear strength of saturated and partially saturated cohesive and cohesionless soils incorporating the effects of stress history and in-situ stress conditions. Fundamentals of lateral earth pressure and classical methods of analysis. Integration of basic techniques of subsurface exploration methods (equipment, sampling tubes, and number of samples) with the above topics to critically analyze stability of earth structures (landslides, slope stability and earth dam stability).

ENCE 644 Engineering Soil Problems of North America (3) Prerequisites: ENCE 340 or equivalent. A critical review of the distribution of the soils in North America with respect to engineering design and construction problems. Design factors such as availability of quality aggregate resouces, soil origin and texture, high volume change soils, potentially poor subgrade support conditions, and frost-susceptible soils.

ENCE 651 Matrix Methods of Structural Analysis (3) Review of basic structural and matrix theory. Development of force and displacement methods with emphasis on the latter. Discussion of special topics such as geometric non-linearity, automated and optimum design non-prismatic members and thin-walled open sections and sub-division of large structures. Emphasis on applications to civil engineering structures.

ENCE 652 Analysis of Plate and Shell Structures (3) Prerequisites: ENCE 410 and ENCE 381 or equivalent. Review of theory of elasticity and in-plane forces; theory of orthotropic plates; approximate methods; large deflection theory, buckling; general theory of shells, cylindrical shells, domes.

ENCE 655 Plastic Analysis and Design of Structures (3) Prerequisite: Permission of instructor. The study of the factors effecting the plastic behavior of steel structures and the criteria necessary for design. The design of beams, rigid frames and multi-story braced frames using current specifications. A review of current research and practice.

ENCE 656 Advanced Steel Design (3) Prerequisite: ENCE 450 and ENCE 451 or equivalent. Interpretation of specifications and codes for the design of steel buildings and bridges. Discussion of the behavior of steel connections, members and structures; the relationship between behavior and design specifications.

ENCE 657 Theory of Structural Design (3) Prerequisite: ENCE 656. Correlation of theory, experience, and experiments in study of structural behavior, proportioning, and preliminary design. Special design problems of fatigue, buckling, vibrations, and impact.

ENCE 660 Engineering Analysis (3)

ENCE 661 Finite Element Techniques in Engineering Analysis (3) Prerequisite: Consent of instructor. Basic principles and fundamental concepts of the finite element method. Consideration of geometric and material nonlinearities, convergence, mesh gradation and computational procedures in analysis. Applications to plane stress and plane strain, plates and shells, eigenvalue problems, axi-symmetric stress analysis, and other problems in civil engineering.

ENCE 670 Highway Traffic Characteristics and Measurements (3) Prerequisite: ENCE 470 or consent of instructor. The study of the fundamental traits and behavior patterns of the road user and his vehicle in traffic. The basic characteristics of the pedestrian, the driver, the vehicle, traffic volume and speed, stream flow and intersection operation, parking, and accidents.

ENCE 671 Highway Traffic Operations (3) Prerequisite: ENCE 470, ENCE 670 or consent of instructor. A survey of traffic laws and ordinances. The design, application and operation of traffic control devices and aids, including traffic signs and signals, pavement markings, and hazard delineation. Capacity, accident, and parking analyses.

ENCE 672 Regional Transportation Planning (3) Prerequisite: ENCE 471 or consent of instructor. Factors involved and the components of the process for planning statewide and regional transportation systems, encompassing all modes. Transportation planning studies, statewide traffic models, investment models, programming and scheduling.

ENCE 673 Urban Transportation (3) Prerequisite: ENCE 672 or consent of instructor. Relationship of transportation to the total urban complex, the urban transportation planning process, the models used to achieve the various steps in the process and the relationship of private and public transportation. Consideration of the factors influencing the demand for transportation and the socio-economic consequences of transportation.

ENCE 674 Urban Transit Planning and Rail Transportation Engineering (3) Prerequisite: ENCE 471 or consent of instructor. Basic engineering components of conventional and high speed railroads and of air cushion and other high speed new technology. The study of urban rail and bus transit. The characteristics of the vehicle, the supporting way, and the terminal requirements will be evaluated with respect to system performance, capacity, cost, and level of service.

ENCE 675 Airport Planning and Design (3) Prerequisite: ENCE 471 or consent of instructor. The planning and design of airports including site selection, runway configuration, geometric and structural design of the landing area, and terminal facilities. Methods of financing airports, estimates of aeronautical demand, air traffic control, and airport lighting are also studied.

ENCE 676 Highway Traffic Flow Theory (3) Prerequisite: ENCE 461, ENCE 462 or consent of the instructor. An examination of physical and statistical laws that are used to represent traffic flow phenomena. Deterministic models including heat flow, fluid flow, and energy-momentum analogies, car following models, and acceleration noise. Stochastic approaches using independent and Markov processes, queuing models, and probability distributions.

ENCE 677 Quantitative Methods in Transportation Engineering (3) Prerequisite: ENCE 461 or consent of instructor. Theory, methods and applications relevant to the study of micro- and macro-scale transportation systems, in terms of their behavior, design, and evaluation. A selected overview of optimization, multivariate statistics, stochastic processes and the general science of systems decision processes will form the basis for a selected study of pertinent examples.

ENCE 688 Advanced Topics in Civil Engineering (1–3) Prerequisite: Permission of instructor. Advanced topics selected by the faculty from the current literature of civil engineering to suit the needs and background of students. May be taken for repeated credit when identified by topic title.

ENCE 689 Seminar (1–16)

ENCE 731 Advanced Ground Water Hydrology (3) Prerequisite: ENCE 432 or equivalent. Theory and application of unsteady flow in porous media. Analysis of one and two dimensional unsteady flow. Solutions of non-linear equation of unsteady flow with a free surface. Development and use of approximate numerical and graphical methods in the study of ground water movement.

ENCE 732 Deterministic Models in Surface Water Hydrology (3) A detained examination of the processes controlling the quantity and quality of watershed runoff: emphasis is on the development of deterministic mathematical models for process simulation; role of land-phase processes in flood hydrology; evaporation and transpiration; models for urban watershed; linkage for hydrograph synthesis.

ENCE 733 Applied Water Chemistry (4) Prerequisite: ENCE 633 or consent of instructor. Three lectures, one lab a week. A study of the chemistry of both municipal and industrial water treatment processes. Among the topics to be considered are water softening, stabilization, chemical destabilization of colloidal materials, ion exchange, disinfection, chemical oxidation and oxygenation reactions.

ENCE 734 Aerosol Science and Technology (3) Prerequisite: ENCE 430 or equivalent. Physical properties of air-borne particles. Theories of: particle motion under the action of external forces; coagulation; Brownian motion and diffusion. Application of aerosols in atmospheric sciences and industrial processes.

ENCE 735 Design of Municipal and Industrial Wastes Treatment Facilities (3) Corequisite: ENCE 736 or equivalent. One lecture and two laboratory periods a week. Application of basic science and engineering science to design of municipal and industrial waste treatment processes; design and economics of unit operations as applied to environmental systems.

ENCE 736 Theory of Aqueous and Solid Waste Treatment and Disposal (3) Prerequisites: ENCE 221 and fundamentals of microbiology, or consent of instructor. Theory and basic principles of treating and handling waste products; hydraulics of sewers; biological oxidation; principles and design criteria of biological and physical treatment processes; disposal of waste sludges and solids.

ENCE 737 Industrial Wastes (3) Corequisite: ENCE 736 or equivalent. A study of the characteristics of liquid wastes from major industries, and the processes producing the wastes. The theory and methods of eliminating or treating the wastes, and their effects upon municipal sewage-treatment plants, and receiving waters.

ENCE 738 Selected Topics in Porous Media Flow (3) Prerequisite: ENCE 731. Analysis of two-liquid flows for immiscible fluids, simultaneous flow of two immiscible fluids and miscible fluids. Hydrodynamic dispersion theories, parameters of dispersion and solutions of some dispersion problems with emphasis on migration of pollutants. A maximum of six hours may be earned in this course.

ENCE 741 Aircraft Remote Sensing in Civil Engineering (3) Prerequisite: ENCE 340 or equivalent or consent of instructor. Theoretical and practical aspects of the use of remote sensing in engineering. Emphasis on the interpretation of aerial photography and infrared, radar, multispectral and other sensor data. The planning of aerial and field remote sensing missons and the applications of these sensors to engineering programs including regional inventories, route locations, environmental surveys and site investigations. Computer analysis of remote sensing data is considered.

ENCE 742 Site Investigation (3) Prerequisite: ENCE 340 or equivalent or consent of instructor. A study of various techniques for evaluating the physical environment and performing exploration programs for engineering facilities. Methods for using various techniques available for engineering site investigations, including interpretation of topographic, geological and agricultural soil maps; and the use of geophysical and subsurface exploration systems.

ENCE 750 Analysis and Design of Structural Systems (3) Prerequisite: ENCE 450 and ENCE 451 or equivalent. Review of classical determinate and indeterminate analysis techniques; numerical technique; multistory buildings; space structures; suspension bridges and cables structures; arches; long span bridges.

ENCE 751 Advanced Problems in Structural Behavior (3) Prerequisite: ENCE 750 or equivalent. Elastic and inelastic behavior of structural members and frames; problems in torsion, stability and bending; open and closed thin-walled sections; curved girders.

ENCE 753 Reinforced Concrete Structures (3) Prerequisite: ENCE 450 and 451 or equivalent. The behavior and strength of reinforced concrete members under combined loadings, including the effects of creep, shrinkage and temperature. Mechanisms of shear resistance and design procedures for bond, shear and diagonal tension. Elastic and ultimate strength analysis and design of slabs. Columns in multistory frames. Applications to reinforced concrete strutures.

ENCE 754 Prestressed Concrete Structures (3) Prerequisite: ENCE 450 and 451 or equivalent. Fundamental concepts of prestressed concrete. Analysis and design of flexural members including composite and continuous beams with emphasis on load balancing technique. Ultimate strength design for shear. Design of post tensioned flat slabs. Various applications of prestressing including tension members, compression members, circular prestressing, frames and folded plates.

ENCE 799 Master's Thesis Research (1–6)

ENCE 899 Doctoral Dissertation Research (1–8)

Communication Arts and Theatre Program

Professor and Chairman: Aylward
Professors: Meersman, Pugliese, Wolvin
Associate Professors: Falcione, Freimuth, Jamieson, Kirkley, Kolker, Linkow, O'Leary, Weiss, G.S.

Assistant Professors: Cline, Conger, duMonceau, Leong, McCaleb, McCleary, Patterson, Philport, Thompson
Lecturer: Niles

The Department of Communication Arts and Theatre offers the Master of Arts degree in each of the three divisions: speech communication; theatre; radio-television-film. Within each of these divisions it is possible to concentrate in specific areas which are described below.

The Department also participates in the Ph.D. degree in Public Communication, which embraces all three divisions and the College of Journalism. Although the Ph.D. program is interdisciplinary within the four areas, a student is free to explore and concentrate in specific areas such as rhetoric and public address, organizational and political communication, governmental communication, broadcast communication, public relations, international communication, science and medical communication, theatrical theory and aesthetics, theatre history and cinema history and aesthetics. For complete information on admission and degree requirements, see the "Public Communication Program" entry.

Admission and Degree Information

For admission to the graduate program in any of the divisions, the applicant must meet all requirements of the Graduate School and provide acceptable Graduate Record Examination Scores. If an applicant does not have the equivalent of an undergraduate major in his field of interest, opportunities exist for him to take course work in preparation for subsequent admission. An M.A. degree in speech communication, radio-television-film, or theatre is normally required for admission to to the doctoral program, but will not in itself guarantee admission. In evaluating applicants for admission, the Department utilizes GRE scores; and in addition, prospective doctoral students are required to submit evidence of scholarly potential.

The Department offers the M.A. degree with thesis and non-thesis options. Along with the minimum requirements established by the Graduate School, each division of CMRT has special requisites for the completion of its own program. Graduate assistants are generally able to complete their 30 hour programs in 18 months, while students without assistantships most often finish in a calendar year.

Radio-Television-Film

A student in the Radio-Television-Film Division may either concentrate in a particular area (film or broadcasting, for example) or elect a more general program covering the multiple aspects of electronic and film communication. A student whose academic goals extend beyond the Radio-Television-Film Division may, upon approval of his advisor, take as many as twelve credit hours in cognate fields in other divisions or other departments of the University. Examples of such programs would include educational uses of media, broadcast management, and electronic journalism.

Students may either pursue a traditional research thesis or complete a production thesis. Before a production thesis will be approved, the student must demonstrate his ability to complete such a project through the submission of a portfolio or equivalent evidence.

Speech Communication

Students who elect to pursue a program of study in the Division of Speech Communication are encouraged to develop programs reflecting an understanding of the genesis, the nature, and the effects of human speech behavior. A student may concentrate within a specialized area of Speech Communication (Political Communication or Organizational Communication, for example) or may elect a more general course of study. Students in the Speech Communication Division are urged to augment their program of study with coursework in complementary disciplines and with communication internships in the Washington, D.C., Metropolitan area.

Theatre

The M.A. program in Theatre is designed to provide the student with opportunities to enhance artistic and creative talents and to develop historical and critical faculties. The student may pursue a general program or specialize in such single areas of concentration as history and criticism, performance, design and technical direction, children's theatre, musical theatre, and arts management. The Division of Theatre offers both the research thesis and the production thesis. Before electing a production thesis, a student must demonstrate proficiency in his/her chosen area of concentration.

Facilities and Special Resources

The University of Maryland is within a few miles of the John F. Kennedy Center for the Performing Arts, Arena Stage, and the National, Ford's and Folger Theatres, and the Wolf Trap Farm Park for the Performing Arts. In addition, a number of Equity and non-Equity dinner theatres and semi-professional experimental theatres abound in the area.

Two of the greatest libraries in the world. The Library of Congress and the Folger Shakespeare Library are in close proximity to Campus. Likewise, students regularly make use of the Broadcast Pioneers Library, the Smithsonian Institution, the National Archives and the more than 50 specialized libraries and institutions in the Washington metropolitan area.

The Department has use of the Tawes Fines Arts Theatre, other smaller theatres on campus, the Communication Research Center and audio and video production facilities.

Financial Assistance

The Department is able to offer approximately one-half of all full-time graduate students teaching or research assistantships. A few additional students are employed in various divisions of the Department; these are required to pay their own tuition and fees.

Additional Information

Descriptions of the Departmental programs and divisions and other information may be obtained by writing to Director of Graduate Studies, Department of Communication Arts and Theatre, University of Maryland, College Park, Md. 20742.

Courses

Radio, Television and Film

RTVF 402 Advanced Sound Production (3) Prerequisite: RTVF 302 and consent of instructor. An advanced sound production methodology in radio drama and documentaries.

RTVF 413 The History of the Film (3) An advanced survey of the film as an art form. Cinema pre-history, actualities and the Lumiere tradition, Melies, Griffith, and their contemporaries, the silent film (1920–29): Germany, Russia, and the U.S.A., screen comedy, the sound film (1926-present): American and foreign master directors, recent and current trends. Recommended prior to this course: RTVF 314.

RTVF 414 Contemporary American Cinema (3) Prerequisite: RTVF 222. An analysis of the trends and major social issues in American culture as they are expressed through the film medium. Emphasis on 'New Wave', experimental, underground, independent, and cinema verite motion pictures.

RTVF 415 Contemporary European Cinema (3) A comparative and critical analysis of the European motion picture both as a distinct art form reflecting the national character of a particular country and as a medium for mass communications demonstrating the universality of the human condition.

RTVF 417 Dramatic Writing for Broadcasting and Film (3) Prerequisite: RTVF 317 or consent of instructor. An introduction to the principles, methods and limitations of writing comedy, drama, and the documentary for radio, television, and film.

RTVF 418 The Film Auteur (3) The intensive chronological study of the work of one European or American film director each semester.

RTVF 419 Film Genres (3) The study of one major film genre each semester The Gangster Film, The Western, Science Fiction and Horror, The Political Film). Cinema develops formal and thematic conventions and how, as a medium for reflecting social ideals and needs. Repeatable to a maximum of six credits.

RTVF 420 The Documentary Film (3) Growth, implication, and the use of the international nonfiction film as propaganda, public service, promotion, education, and entertainment. Case studies from representative documentaries will be analyzed.

RTVF 421 Film Criticism and Theory (3) Critical-aesthetic approaches to film in order to develop a vocabulary for film analysis. Included will be shot analysis; montage and deep focus; the Auteur theory; the role of screenwriter, director of photography, actor; genre analysis; analysis of film as popular art.

RTVF 425 Television and Politics (3) Critical review of studies of the effects of political broadcasts; legal and social issues; surveys and media campaigns.

RTVF 440 Television Direction (3) Prerequisites: RTVF 340 and consent of instructor. Principles of television direction including elements of composition, picturization, timing, script notation and program coordination.

RTVF 441 Television Direction II (3) Prerequisite: RTVF 440 or consent of instructor. Advanced theories of television direction; script analysis and adaptation, production coordination, casting, blocking, rehearsals and mixing.

RTVF 449 Television Workshop (3) Two-hour lecture, four-hour laboratory. Prerequisites: RTVF 340, 440 and consent of instructor.

RTVF 450 Radio and Television Station Management (3) The role of the manager in the modern broadcasting industry. Station communication factors, regulation, licensing, personnel functions, sales, programming supervision, audience analysis, and station promotion.

RTVF 451 Broadcast Criticism (3) An analysis of the professional, historical, social, and psychological criticism of American radio and television, together with practical application of professional and scholarly critical methods.

RTVF 452 International and Comparative Broadcasting Systems (3) A comparative study of international broadcasting program policies, economic systems, control and organization. The use of broadcasting in international affairs as an instrument of propaganda, culture and information dissemination. Monitoring of overseas broadcasts, television programs and discussions with representatives of domestic and foreign international broadcast agencies.

RTVF 453 Broadcast Regulation (3) Prerequisite: RTVF 223. Legal issues involving radio and television: freedom, restraints, self-regulation; regulation of programming, competition, rights as seen by the broadcaster, regulatory agencies and the public.

RTVF 454 Cable Television (3) Prerequisite: RTVF 223. History, regulatory development, system designs, communications capability and franchising of cable television.

RTVF 466 Film Production III, Synchronized Sound Film Systems (3) Prerequisites: RTVF 355 and consent of instructor. Synchronized sound and color technology with emphasis on the 16mm format.

RTVF 467 Film Production IV, Advanced (3) Prerequisites RTVF 464 and consent of instructor. Direction and production of 16mm, color, synchronized sound motion picture. Production management, cinematography, and sound recording.

RTVF 498 Seminar (3) Prerequisites: Senior standing and consent of instructor. Present day radio-television-film research. Repeatable to a maximum of six credits.

RTVF 600 Introduction to Graduate Study in Broadcasting (3)

RTVF 601 Visual Communication (3) A theoretical analysis of aspects of perception; effects of visual messages in human communication through television and film.

RTVF 621 Formal Film Analysis (3) The elements and composition of intensive analysis of selected narrative films on a shot by shot basis.

RTVF 628 Seminar in Film (3) Studies of various aspects of film. Subject matter changed each semester. Repeatable to a maximum of 6 credits.

RTVF 629 Special Problems in Film (3) An experimental course for the development of new ideas in film. May be repeated to a maximum of 6 credits, if subject is different.

RTVF 640 Advanced Television Direction (3) Prerequisite: RATV 440 or consent of instructor. Principles of television direction as applied to dramatic programs, together with a consideration of the specific aesthetic values of the television medium.

RTVF 642 History of Broadcasting (3) Seminar study of the individuals, technological developments, and social and economic factors responsible for the development and direction of the broadcast media in the United States.

RTVF 648 Seminar in Broadcasting (3) Studies of various aspects of broadcasting. Subject matter changed each semester.

RTVF 649 Special Problems in Broadcasting (3) An experimental course for the development of new ideas in broadcasting.

RTVF 662 Seminar in Political Broadcasting (3) A seminar integrating the theory of mass communication with rhetorical-critical theory in an analysis of major political uses of the broadcast media.

RTVF 666 Producing and Production Management for Film (3) Prerequisites: RTVF 357 or equivalent. Management problems facing independent and organizational filmmakers, budgeting, production management, unions, financing, insurance, taxes, and distribution.

RTVF 699 Independent Study (1–3)

RTVF 799 Master's Thesis Research (1–6)

Speech

SPCH 400 Introduction to Research Methodologies in Speech Communication (3) Prerequisite: Speech communication major or minor or consent of the instructor. An introductory survey of empirical and historical—critical research methodologies in speech communication. The course is designed to prepare the student to understand and to conduct basic research in the field.

SPCH 420 Advanced Group Discussion (3) Prerequisite: SPCH 220 or consent of the instructor. An examination of current research and techniques in the discussion and conference, including extensive practice in various types of discussions. Emphasis is upon small group leadership and dynamics.

SPCH 422 Interviewing (3) Prerequisite: Permission of instructor. Speech principles and practices basic to recognized types of interview, giving special attention to behavioral objectives and communication variables involved in the process of interviewing.

SPCH 423 Communication Processes in Conferences (3) Prerequisite: One course in speech communication or consent of the instructor. Group participation in conferences, methods of problem solving, semantic aspects of language, and the function of conferences in business, industry and government settings.

SPCH 424 Business, Industrial and Government Communication (3) Prerequisite: Permission of the instructor. Structure, methodology and application of communication theory in the industrial setting will be emphasized.

SPCH 440 Advanced Oral Interpretation (3) Prerequisite: SPCH 240. A study of the advanced theories and techniques employed in the interpretation of prose, poetry and drama. Attention is given to selections, analyses, cuttings, script compilations, and the planning of programs and performances in oral interpretation.

SPCH 441 Readers Theatre (3) Prerequisite: SPCH 240 or consent of the instructor. Theories and techniques of readers theatre will be analyzed to enhance the interpreting and directing abilities of students. Special attention will be given to interpretation and direction of prose, drama, and script compilation.

SPCH 450 Classical and Medieval Rhetorical Theory (3) Prerequisite: SPCH 200 or consent of instructor. The theories of speech-making and speech composition as propounded by the classical rhetoricians. Special attention is given to Plato, Aristotle, Socrates, Cicero, Quintilian, and St. Augustine.

SPCH 451 Renaissance and Modern Rhetorical Theory (3) Prerequisite: SPCH 200 or consent of the instructor. A study of the development of modern rhetorical theories in Europe and America with consideration of the application of the theories to public address. Special attention is given to Thomas Sheridan, John Walker, George Campbell, Hugh Blair, Richard Whately, James A. Winans, Charles Woolbert, I.A. Richards, and Kenneth Burke.

SPCH 455 Speechwriting (3) Prerequisite: SPCH 200 or consent of the instructor. Intensive study of rhetorical principles of speech composition through study of model speeches and through a practicum in speech writing. Emphasis will be placed on the application of research in speech writing to various forms and styles of speeches.

SPCH 460 American Public Address 1635–1900 (3) Prerequisite, SPCH 200 or consent of major historical movements and influential spokesmen from 1635–1900. Emphasis on the reign of theocracy, the American Revolution, the presidential inaugural as a rhetorical type, the Compromise of 1850, the Lincoln-Douglas Debates, the Civil War rhetoric and The Populist Movement.

SPCH 461 American Public Address in the 20th Century (3) Prerequisite: SPCH 200 or consent of instructor. Course examines the rhetorical development of major historical movements and influential spokesmen from 1900 to the present. Focus on the progressive movement the rise of labor, women's suffrage, McCarthyism and the evolution of pro- and anti-war rhetoric.

SPCH 462 British Public Address (3) Prerequisite: SPCH 200 or consent of the instructor. A biographical, textual and critical-rhetorical study of great british speakers and their influences. Special attention will be devoted to the 'Golden Age' of British Oratory and to the forms and styles of contemporary speakers.

SPCH 470 Listening (3) A study of the listening process, listening variables, listening levels, and the development of effective listening behavior.

SPCH 472 Nonverbal Communication (3) Survey of nonverbal communication in human interaction; theory and research on proxemics, kinesics and paralinguistics as expression of relationship, affect and orientation within and across cultures.

SPCH 474 Communication Theory and Process (3) A general survey of introductory material in communication theory.

SPCH 475 Persuasion in Speech (3) Prerequisite: SPCH 200 or 230. A study of the bases of persuasion with emphasis on recent experimental developments in persuasion.

SPCH 476 Foundations of Speech Behavior (3) This course will provide a study of the acquisition of speech, the elements that influence speech behavior, the influences of speech behavior, and a theoretical framework for the analysis of communication situations. Students will apply the theory to analysis of specific communication situations.

SPCH 477 Speech Communication and the Study of Language Acquisition (3) Survey of language acquisition and development in human communication behavior; theory and research on language structure, syntactic, phonological, and cognitive systems as an influence of an individual's orientation and development within and across cultures.

SPCH 478 Speech Communication Colloquim (1) Current trends and issues in the field of speech communication, stressing recent research methods. Recommended for senior and graduate student majors and minors in speech communication. Repeatable to a maximum of 4 hours.

SPCH 482 Intercultural Communication (3) The major variables of communication in an intercultural context. Communication problems created by cultural, racial, and national differences; analysis of stereotypes, values, and cultural assumptions influencing verbal and nonverbal communication.

SPCH 483 Urban Communication (3) A study of communication variations in the urban community, exploration of strategies for improving communication.

SPCH 488 Speech Communication Internship (1–6) Registration by permission of adviser only. This independent internship is designed to give the speech communication student practical career experience with a speech communication professional in the Washington metropolitan area. Limited to a maximum of six credits.

SPCH 489 Speech Communication Workshop (1–6) Workshops devoted to special, in-depth study in speech communication. Course may be repeatable to a maximum of six semester hours.

SPCH 498 Seminar (3) Prerequisites: Senior standing and consent of instructor. Present-day speech research.

SPCH 499 Honors Seminar (3) For honors students only. Readings, symposiums visiting lectures, discussions.

SPCH 600 Empirical Research in Speech Communication (3)

SPCH 601 Historical-Critical Research in Speech Communication (3) Intense study in critical and historical methodology as applicable to research in speech communication. Emphasis will be placed on the composition and the evaluation of historical-critical studies of significance in the field of rhetorical communication scholarship.

SPCH 628 Organization Communication: Research and Intervention (3) Prerequisite: SPCH 424 or consent of the instructor. The role of the internal and external communication consultant as an organization change agent. Emphasis upon data gathered to facilitate the communication development of the organization. Repeatable to a maximum of 6 credits.

SPCH 655 Seminar in Speechwriting (3) Theoretical and practical aspects of speechwriting at an advanced level.

SPCH 670 Seminar in Listening Behavior (3) Prerequisite: SPCH 470 or consent of instructor. A study of research in and measurement of listening behavior.

SPCH 680 Speech Communication Programs in Education and Training (3) An analysis of instructional development in speech communication. Instructional objectives, strategies and evaluation are applied to educational, corporate and industrial training programs.

SPCH 688 Speech Communication Field Experience (1–6) Prerequisite: Consent of the instructor. Applications of speech communication principles and research in professional communication settings.

SPCH 698 Special Problems in Speech Communication (3)

SPCH 720 Seminar in Small Group Communication (3) The seminar will explore the variables involved in small group communication (formation and membership, leadership, functions, and current research problems). The focus of the course will be two-fold: (1) to give the student a survey of small group communication theory, and (2) to provide some in-depth analysis of current problems in small group communication.

SPCH 724 Seminar in Organizational Communication (3) Prerequisite: Permission of the instructor. Theories and problems of human communication within, between, and/or among formal organizations will be emphasized.

SPCH 755 Seminar in Rhetorical Theory (3) Second semester. Prerequisite: SPCH 460, 461 or 450. Examination of selected theories of style drawn from the fields of rhetoric and literature, and analysis of model speeches.

SPCH 760 Seminar in Political Communication (3) Prerequisite: SPCH 601 or consent of the instructor. A

blend of theory and practice to integrate rhetorical-critical theory and empirical methods with politics. Practitioners in political communication will be drawn in as resource persons. Students will map the communication strategy for candidates and analyze actual campaign strategies.

SPCH 762 Seminar in Public Address (3) An in-depth study of national and international speakers and issues throughout the history of the spoken word. Emphasis will be placed upon the application of rhetorical principles to the analysis of world speakers and their speeches.

SPCH 775 Seminar in Persuasion and Attitude Change (3) This seminar will concentrate on the problem of making message strategy decisions. Course content will consist of study of both theoretical and empirical research on attitude and attitude change in persuasive communication.

SPCH 776 Interpersonal Communication (3) Problems and processes of symbolic representation in speech, the effects of language on communication, semantic redundancy, and interaction between meaning and the structure of oral language.

SPCH 798 Independent Study (1–3) Prerequisite: Consent of instructor. An individual course designed for intensive study or research of problems in any one of the three areas of drama, general speech, or radio/TV.

SPCH 799 Master's Thesis Research (1–6)

Theatre

THET 420 Styles and Theories of Acting (3) Prerequisites: THET 120, 221, 320 or consent of instructor. Emphasis on the philosophical basis and techniques necessary for acting modern realistic drama and acting period style dramas. In-depth study of Stanislavski system and application of those techniques toward performance in scenes. Examination and application of the techniques necessary for the preparation and performance of an acting score for performing Shakespeare. Improvisation. Required attendance at live theatre productions.

THET 429 Actor's Studio (1–3) Prerequisite: Consent of instructor. Participation in dramatic roles executed under faculty supervision in the department's productions. Eligible students must make commitments and plan performances with course instructor during preregistration. Repeatable to a maximum of six credits.

THET 430 Advanced Directing for the Stage (3) Prerequisite: THET 330 or consent of instructor. Discussion of the preparation procedures and rehearsal practices necessary for the presentation of a variety of theatrical styles and forms. Emphasis on understanding the relationship between the director, the actor, the script and the audience. A series of student directed scenes supplemented by attendance at theatre productions.

THET 440 Children's Dramatics (3) Principles and methods of creative dramatics as applied in the classroom or community center for elementary, secondary and exceptional children. Supervised conducting of classes in creative dramatics at the University, nearby community centers or schools.

THET 445 Directing Plays for Children's Theatre (3) Prerequisite: THET 440. An introduction into the formal elements of directing plays for children. The organization of large groups of children in the framework of children's theatre. History of children's theatre, script analysis, and basic directing skills for staging children's theatre. A final presentation of a short established or original children's play is required.

THET 450 American Musical Comedy (3) The evolution of musical comedy through opera to early American extravaganzas and minstrels to the musicals of the 1920's and 1930's. The development and highlights of the form since 1940. The function and form of the libretto, music and lyrics, and the roles of the creative personnel of a musical production. Workshops in performance skills.

THET 460 Theatre Management I (3) The practical tools of theatre management. production philosophies, selecting and balancing a season, tickets and box office procedures, budgeting, graphic arts production, advertising, publicity and other promotional devices.

THET 461 Theatre Management II (3) Prerequisite: THET 460 or consent of instructor. Case studies, discussions, lectures and projects concerning advance theatre management decision making and administration, including such areas as personnel relations, contract negotiations, theatrical unions, fund raising, touring, audience development and public relations.

THET 471 Advanced Scenic Design (3) Prerequisites: THET 170, 273, 375 or consent of instructor. Study of period styles and techniques in scenic design. Emphasis on individual projects and multi-use theatres.

THET 476 Principles and Theories of Stage Lighting (3) Prerequisite: THET 170, recommended THET 273. A study of the theories of electrification, instruments, design, color, and control for stage and television. Brief survey of sound for the theatre. Practical work on productions.

THET 477 Advanced Lighting Design (3) Prerequisite: THET 476. Study of history and theory of lighting design. Design exercises in proscenium, in-the-round, thrust, outdoor pageant, circus, concert, spectacle, dance and television lighting. A survey of lighting companies and equipment and architectural lighting.

THET 479 Theater Workshop (1–3) Prerequisite: THET 170 and permission of the instructor. Participation in the technical aspects of theatre production in selected University and experimental theatre productions. Repeatable to a maximum of six credits.

THET 480 Stage Costume Design I (3) Prerequisite: THET 282. Basic principles of theatre costume design and introduction to rendering skills. Emphasis on development of design conception, unity, character statement, basic clothing design and period style adaptation.

THET 481 Stage Costume Design II (3) One lecture and six hours of laboratory per week. Prerequisite: THET 480. An advanced study of costume design and interpretation leading to understanding and facility in design of stylized productions. Emphasis on design for musical comedy, dance theatre, opera and various non-traditional forms of theatre production.

THET 485 Advanced Makeup (3) Prerequisite: THET 180 or consent of instructor. Advanced techniques and materials in makeup for the theatre, television and film. Practical work with three-dimensional makeup (prosthetic devices), hair pieces, mask-making and sylized makeup. Opportunity to develop skills in a creative approach to makeup design.

THET 490 History of the Theatre I (3) Evolution of the theatre from primitive origins, through the early renaissance with emphasis on playwrights and plays, theatre architecture and decor, and significant personalities. Extensive use of graphic material, play reading, related theatre-going

THET 491 History of the Theatre II (3) A continuation of THET 490 beginning with the 16th century and progressing into the 20th, examining the late Renaissance, Elizabethan, Restoration, 17th to 19th century European, and early American theatres. Emphasis on dramatic forms and styles, theatre architecture and decor, and significant personalities. Extensive use of graphic material, play reading, related theatre-going

THET 495 History of Theatrical Theory and Criticism (3) The development of theatrical theory and criticism from the Greeks to the modern theorist. The philosophical basis of theatre as an art form. Important theorists and the practical application of their theories in either play scripts or theatrical productions. Required attendance at selected live theatre productions.

THET 499 Independent Study (3) Prerequisite: Permission of instructor. An independent study course in which each student completes an assigned major theatre project under close faculty supervision. Projects may culminate with term papers, scenic or costume designs, or a stage production. Repeatable to a maximum of six credits.

THET 600 Introduction to Graduate Study in Theatre (3)

THET 669 Independent Study (1–3)

THET 678 Theory of Visual Design for the Performing Arts (3) Prerequisite: THET 375 or consent of instructor. An historical and theoretical study of design practices in the performing arts.

THET 688 Special Problems in Drama (3) The preparation of adaptations and other projects in dramaturgy

THET 689 Theories of the Drama (3) Advanced study of the identification and development of dramatic form from the early Greek drama to contemporary forms; the aesthetics of theatre arts; and dramatic criticism.

THET 698 Seminar—Studies in Theatre (3) Research projects adapted to individual backgrounds and special work.

THET 699 The Theory of Pre-Modern Dramatic Production (3) An historical survey of production styles.

THET 799 Master's Thesis Research (1–6)

Comparative Literature Program

Professor and Director: Fuegi
Professors: Barry, Best, Bryer, Freedman, Goodwyn, Gramberg, Hering, Holton Jones, MacBain, Panichas, J. Russell, Salmanca, Whittemore
Associate Professors: Beiken, Coogan, Demaitre, Fink, Fleck, Greenwood, Mack, C. Russell
Assistant Professors: Peterson

The Program in Comparative Literature offers graduate work leading to the degrees of Master of Arts and Doctor of Philosophy.

The CMLT Program draws on a distinguished faculty in several departments and offers concentrated work in Medieval and Renaissance studies, and in major movements and genres of the modern period including the Eighteenth Century. Though the focus of courses and seminars is usually specifically literary, interdisciplinary work is very much encouraged as is practical criticsm in the arts. Departments cooperating in the Program include: American Studies, Classics, English, French and Italian, German and Slavic, History, Spanish and Portuguese, Dramatic Arts, Radio-Television-Film, and the Women's Studies Programs.

Admission and Degree Information

Applicants should have a strong background in the arts and humanities. Since advanced work in Comparative Literature is based on the premise that literature should be read in the original whenever possible, students are expected to be able to read at least one language other than English with a high degree of aesthetic appreciation. Ph.D. students are expected to use at least two foreign languages actively in their work, and it is assumed that efforts will be made to develop an acquaintance with one or two additional languages. Entrance examinations are not required, but high scores on GRE literature and language examinations will add weight to applications.

Students take courses in CMLT and in two other departments of literature. The M.A. degree requires thirty hours, either 24 hours of course work and a thesis, or thirty hours of course work and a comprehensive examination. No specific number of hours is required for the Ph.D., as the number will vary according to the preparation and goals of the individual student; the average has been eight to ten courses beyond the M.A. A Master's degree is a required step toward the Ph.D. The Ph.D. comprehensive examinations cover four major areas, determined after consultation with the individual student's committee.

Facilities and Special Resources

The resources of the Kennedy Center, the Folger Library, the American Film Institute, Kennan Institute, and Dumbarton Oaks are regularly drawn upon as are internship possibilities in the greater Washington area and graduate exchange programs with European Universities.

Financial Assistance

Various assistantships and general university fellowships are available. CMLT students may teach in various departments cooperating in the CMLT Program and may be considered for a year abroad as a teacher at cooperating European universities.

Courses

CMLT 401 Introductory Survey of Comparative Literature (3) Survey of the background of European literature through study of Greek and Latin literature in English translations, discussing the debt of modern literature to the ancients.

CMLT 402 Introductory Survey of Comparative Literature (3) Study of the medieval and modern continental literature.

CMLT 411 The Greek Drama (3) The chief works of Aeschylus, Sophocles, Euripides, and Aristophanes in English translations. Emphasis on the historic background, on dramatic structure, and on the effect of the attic drama upon the mind of the civilized world.

CMLT 415 The Old Testament as Literature (3) A study of sources, development and literary types.

CMLT 416 New Testament as Literature A study of the books of the New Testament, with attention to the relevant historical background and to the transmission of the text. A knowledge of Greek is helpful, but not essential.

CMLT 421 The Classical Tradition and its Influence in the Middle Ages and the Renaissance. (3) Emphasis on major writers. Reading knowledge of Greek or Latin required.

CMLT 422 The Classical Tradition and its Influence in the Middle Ages and the Renaissance. Emphasis on major writers. Reading knowledge of Greek or Latin required.

CMLT 430 Literature of the Middle Ages (3) Narrative, dramatic and lyric literature of the Middle Ages studied in translation.

CMLT 433 Dante and the Romance Tradition (3) A reading of the Divine Comedy to enlighten the discovery of reality in western literature.

CMLT 461 Romanticism—Early Stages (3) Emphasis on England, France and Germany. Reading knowledge of French or German required.

CMLT 462 Romanticism—Flowering and Influence (3) Emphasis on England, France and Germany. Reading knowledge of French or German required.

CMLT 469 The Continental Novel (3) The novel in translation from Stendhal through the existentialists, selected from literatures of France, Germany, Italy, Russia, and Spain.

CMLT 470 Ibsen and the Continental Drama (3) Emphasis on the major work of Ibsen, with some attention given to selected predecessors, contemporaries and successors.

CMLT 479 Major Contemporary Authors (3)

CMLT 488 Genres (3) A study of a recognized literary form, such as tragedy, epic, satire, literary criticism, comedy, tragicomedy, etc. The course may be repeated for cumulative credit up to six hours when different material is presented.

CMLT 489 Major Writers (3) Each semester two major writers from different cultures and languages will be studied. Authors will be chosen on the basis of significant relationships of cultural and aesthetic contexts, analogies between their respective works, and the importance of each writer to his literary tradition.

CMLT 496 Conference Course in Comparative Literature (3) Second semester. A tutorial type discussion course, correlating the courses in various literatures which the student has previously taken with the primary themes and masterpieces of world literature. This course is required of undergraduate majors in comparative literature, but must not be taken until the final year of the student's program.

CMLT 498 Selected Topics in Comparative Literature (3)

CMLT 601 Problems in Comparative Literature (3)

CMLT 610 Folklore in Literature (3)

CMLT 631 The Medieval Epic (3)

CMLT 632 The Medieval Romance (3)

CMLT 639 Studies in the Renaissance (3) Repeatable to a maximum of nine hours.

CMLT 640 The Italian Renaissance and its Influence (3)

CMLT 642 Problems of the Baroque in Literature (3)

CMLT 649 Studies in Eighteenth Century Literature (3) Studies in eighteenth century literature: as announced. Repeatable to a maximum of 9 hours.

CMLT 658 Studies in Romanticism (3) Studies in Romanticism: as announced. Repeatable to a maximum of 9 hours.

CMLT 679 Seminar in Modern and Contemporary Literature (3) Seminar in modern and contemporary literature: as announced. Repeatable to a maximum of 9 hours.

CMLT 681 Literary Criticism—Ancient and Medieval (3)

CMLT 682 Literary Criticism—Renaissance and Modern (3)

CMLT 799 Master's Thesis Research (1–6)

CMLT 801 Seminar in Themes and Types (3)

CMLT 899 Doctoral Dissertation Research (1–8)

Computer Science Program

Professor and Chairman: Yeh
Professors: Atchison, Chu[2], Edmundson[3], Kanal, Minker[4], Stewart[4]
Associate Professors: Agrawala, Austing, Basili, Hamlet, Rieger, Shneiderman Zelkowitz
Assistant Professors: Brodie, Dowdy, Gannon, Gligor, Jacobs, Kim, Nau, O'Leary, Privitera, Samet, Tripathi, Weiser, Zave
Research Professor: Rosenfeld[1]
Adjunct Professor: Mills, H

[1]joint appointment with Computer Science Center.
[2]joint appointment with Electrical Engineering.
[3]joint appointment with Mathematics
[4]joint appointment with Insitute for Physical Science and Technology.

The Department of Computer Science offers graduate programs leading to the degrees of Master of Science and Doctor of Philosophy in the following areas: applications, artificial intelligence, computer systems, information processing, numerical analysis, programming languages, and theory of computing.

Admission and Degree Information

Admission and degree requirements specific to the graduate programs in computer science are described in a brochure available through the Departmental Education Office. There are two options for the master's degree: 24 hours of course work plus the completion of a thesis: or 33 hours of course work, a comprehensive examination plus the completion of a scholarly paper. There is no minimum course requirement in the doctoral program. The number and variety of courses offered each semester enables students and their advisors to plan individualized degree programs.

Facilities and Special Resources

The Department maintains a laboratory consisting of several PDP 11/45 computer systems, display devices, peripheral equipment, and utilizes the UNIVAC 1108/1140 computer system maintained by the Computer Science Center.

Additional Information

For information on degree programs and graduate assistantships, contact: Dr. Richard H. Austing, Department of Computer Science.

Courses

CMSC 400 Introduction to Computer Languages and Systems (3) Prerequisite: MATH 241 or equivalent. A terminal course suitable for non-CMSC majors with no programming background. Organization and characteristics of computers. Procedure oriented and assembly languages. Representation of data, characters and instructions. Introduction to logic design and systems organization. Macro definition and generation. Program segmentation and linkage. Extensive use of the computer to complete projects illustrating programming techniques and machine structure. (CMSC 400 may not be counted for credit in the graduate program in Computer Science.)

CMSC 411 Computer System Architecture (3) Prerequisite: CMSC 311 or equivalent. Input/output processors and techniques. Intra-system communication, buses, caches. Addressing and memory hierarchies. Microprogramming, parallelism, and pipeling

CMSC 412 Operating Systems (3) Prerequisite: CMSC 311 or equivalent. An introduction to batch systems, spooling systems, and third-generation multiprogramming systems. Description of the parts of an operating system in terms of function, structure, and implementation. Basic resource allocation policies.

CMSC 415 Systems Programming (3) Prerequisite: CMSC 220, 410. Basic algorithms of operating system software. Memory management using linkage editors and loaders, dynamic relocation with base registers, paging. File systems and input/output control. Processor allocation for multiprogramming, timesharing. The emphasis of the course is on practical systems programming, including projects such as a simple linkage editor, a stand-alone executive, a file system, etc.

CMSC 420 Data Structures (3) Prerequisite: CMSC 220 or equivalent. Description, properties, and storage allocation of data structures including lists and trees. Algorithms for manipulating structures. Applications from areas such as data processing, information retrieval, symbol manipulation, and operating systems.

CMSC 426 Image Processing (3) Prerequisite: CMSC 420 or equivalent. An introduction to basic techniques of analysis and manipulation of pictorial data by computer. Image input/output devices, image processing software, enhancement, segmentation, property measurement, fourier analysis. Computer encoding, processing, and analysis of curves.

CMSC 430 Theory of Language Translation (3) Prerequisite: CMSC 120 and 250, or equivalent; CMSC 330 recommended. Formal translation of programming languages, program syntax and semantics. Finite state grammars and recognizers. Context free parsing techniques such as recursive descent, prededence, LL(K), LR(K) and SLR(K). Machine independent code improvement and generation, syntax directed translation schema. Not open to students who have credit for CMSC 440.

CMSC 432 Compiler Writing (3) Prerequisites: CMSC 220, 330, 430. A detailed examination of a compiler for an algebraic language designed around the writing of a compiler as the major part of the course. Scanning and parsing, code generation, optimization and error recovery, and compiler-writing techniques such as bootstrapping and translator writing systems.

CMSC 435 Software Design and Development (3) Prerequisite: CMSC 420 and 430, or equivalent. State-of-the-art techniques in software design and development. Laboratory experience in applying the techniques covered. Structured design, structured programming, top-down design and development, segmentation and modularization techniques, iterative enhancement, design and code inspection techniques, correctness, and chief-programmer teams. The development of a large software project.

CMSC 450 Elementary Logic and Algorithms (3) Prerequisite: MATH 240 or consent of instructor. This is the same course as MATH 444. An elementary development of propositional logic, predicate logic, set algebra, and Boolean algebra, with a discussion of Markov algorithms, turing machines and recursive functions. Topics include post productions, word problems, and formal languages.

CMSC 452 Elementary Theory of Computation (3) Prerequisites: CMSC 120, 250. This course is intended to serve two purposes: (1) an introduction to the theory of computation, and (2) a tie between many abstract results and their concrete counterparts. This course establishes a theoretical foundation for the proper understanding of the inherent limitations and actual power of digital computers. Also, it provides a relatively uniform way of stating and investigating problems that arise in connection with the computation of particular functions and certain classes of functions. Topics covered include an introductory treatment of classes of computable functions, computability by register machines, computability by turing machines, unsolvable decision problems, concrete computational complexity, and complexity of loop programs.

CMSC 455 Elementary Formal Language Theory (3) Prerequisites: CMSC 120, 250. This course is intended to serve as an introduction to the theory of formal languages. This theory is encountered in the study of both programming languages and natural languages, and consequently will be useful in numerous other courses in Computer Science at the undergraduate and graduate levels. Topics covered include the highlights of Chomsky's hierarchy of grammars and Chomsky's hierarchy of languages, a summary treatment of acceptors related to these languages, and a brief introduction to the theory of transformational grammars.

CMSC 460 Computational Methods (3) Prerequisites: MATH 240, 241, and CMSC 110, or equivalent. Basic computational methods for interpolation, least squares, approximation, numerical quadrature, numerical solution of polynomial and transcendental equations, systems of linear equations and initial value problems for ordinary differential equations. Emphasis on the methods and their computational properties rather than on their analytic aspects. (Listed also as MAPL 460.)

CMSC 470 Numerical Mathematics: Analysis (3) Prerequisites: MATH 240 and 241, CMSC 110 or equivalent. This course with MAPL/CMSC 471, forms a one-year introduction to numerical analysis at the advanced undergraduate level. Interpolation, numerical differentiation and integration, solution of nonlinear equations, acceleration of convergence, numerical treatment of differential equations. Topics will be supplemented with programming assignments. (Listed also as MAPL 470.)

CMSC 471 Numerical Mathematics: Linear Algebra (3) Prerequisites: MATH 240 and 241; CMSC 110 or equivalent. The course, with MAPL/CMSC 470, forms a one-year introduction to numerical analysis at the advanced undergraduate level. Direct solution of linear systems, norms, least squares problems, the symmetric eigen-value problem, basic iterative methods. Topics will be supplemented with programming assignments. (Listed also as MAPL 471.)

CMSC 475 Combinatorics and Graph Theory (3) Prerequisite: MATH 240 and MATH 241. General Enumeration methods, difference equations, generating functions. Elements of graph theory, matrix representations of graphs, applications of graph theory to transport networks, matching theory and graphical algorithms. (Also listed as MATH 475.)

CMSC 477 Optimization (3) Prerequisites: CMSC 110 and MATH 405 or MATH 474. Linear programming including the simplex algorithm and dual linear programs, convex sets and elements of convex programming, combinatorial optimization integer programming. (Listed also as MAPL 477.)

CMSC 480 Simulation of Continuous Systems (3) Prerequisite: CMSC 280 or equivalent. Introduction to digital simulation; simulation by mimic programming; simulation by fortran programming; simulation by DSL/90 (or CSMP) programming; logic and construction of a simulation processor; similarity between digital simulations of continuous and discrete systems.

CMSC 498 Special Problems in Computer Science (1–3) Prerequisite: Permission of instructor. An individualized course designed to allow a student or students to pursue a specialized topic or project under the supervision of the senior staff. Credit according to work done.

CMSC 612 Computer Systems Theory (3) Prerequisite: CMSC 411, CMSC 412, CMSC 250, and STAT 400, or equivalent. Basic theoretical results in computer systems, including synthetic models of system structure, analytical (probabilistic) models of system structure, analysis of computer system mechanisms, analysis of operating system mechanisms, and analysis of resource allocation policies.

CMSC 620 Problem Solving Methods in Artificial Intelligence (3) Prerequisites: CMSC 420 and 450. Underlying theoretical concepts in solving problems by heuristically guided trial and error search methods. State-space problem reduction, and first-order predicate calculus representations for solving problems. Search algorithms and their 'optimality' proofs.

CMSC 630 Theory of Programming Languages (3) Prerequisite: CMSC 430. Syntactic and semantic models of programming languages. Finite state processors and their application to lexical analysis. Context free languages, LR(K), precedence languages as models of programming languages. Extensions to context free grammars such as property grammars, inherited and synthesized attributes, Van Wijngearden grammars (ALGOL 68), abstract syntax, the Vienna definition language, graph models. Translator writing systems.

CMSC 640 Computability and Automata (3) Introduction to formal treatment of abstract computing devices and the concept of 'effective procedure'. Major topics: (1) Finite-state automata. Finite-state transducers and acceptors, finite-state languages, regular expressions and sets. (2) Turing machines, computability, and partial recursive functions. The turing formalism as a model of the computation process: (3) Representative models of digital computers.

CMSC 660 Algorithmic Numerical Analysis (3) Prerequisites, MATH/CMSC 460 or 470, and CMSC 110. Detailed study of problems arising in the implementation of numerical algorithms on a computer. Typical problems include rounding errors, their estimation and control; numerical stability considerations; stopping criteria for converging processes; parallel methods. Examples from linear algebra, differential equations, minimization. (Also listed as MATH 684).

CMSC 700 Translation of Programming Languages (3) Prerequisites: CMSC 420 and 440. Application of theoretical concepts developed in formal language and automata theory to the analytic design of programming languages and their processors. Theory of push-down automata, precedence analysis, and bounded-context syntactic analysis as models of syntactic portion of translator design. Design criteria underlying compiler techniques, such as backtracking and lookahead. Methods for analyzing translator operation in terms of estimating storage space and translation time requirements. Current version of Backus-Naur form. Associated semantic notations for specifying the operation of programming language translators.

CMSC 710 Simulation of Computers and Software (3) Prerequisite: CMSC 410 or equivalent. Computer simulation language, marco and micro simulation, Boolean translation, software-hardware transformation, description and simulation of a microprogrammed computer, construction and simulation of an assembler, project for unified hardware-software design.

CMSC 720 Information Retrieval (3) Prerequisite: CMSC 420. Designed to introduce the student to computer techniques for information organization and retrieval of natural language data. Techniques of statistical, syntactic and logical analysis of natural language for retrieval, and the extent of their success. Methods of designing systems for use in operational environments. Applications to both data and document systems.

CMSC 723 Computational Linguistics (3) Prerequisite: CMSC 420. Introductory course on applications of computational techniques to linguistics and natural-language processing. Research cycle of corpus selection, pre-editing, key-punching, processing, post-editing, and evaluation. General-purpose input, processing, and output routines. Special-purpose programs for sentence parsing and generation, segmentation, idiom recognition, paraphrasing, and stylistic and discourse analysis. Programs for dictionary, thesaurus, and concordance compilation, and editing. Systems for automatic abstracting, translation, and question-answering.

CMSC 725 Mathematical Linguistics (3) Prerequisites: CMSC 640 and STAT 400. Introductory course on applications of mathematics to linguistics. Elementary ideas in phonology, grammar, and semantics. Automata, formal grammars and languages. Chomsky's theory of transformational grammars, Yngve's depthhypothesis and syntactic complexity. Markov-chain models of word and sentence generation, Shannon's information theory, Carnap and Bar-Hillel's semantic theory, lexicostatistics and stylostatistics, Zopf's Law of Frequency and Mandelbrot's Rank Hypothesis. Mathematical models as theoretical foundation for computational linguistics.

CMSC 730 Artificial Intelligence (3) Prerequisites: CMSC 620 and STAT 401. Heuristic programming; tree search procedures. Programs for game playing, theorem finding and proving, problem solving; multiple-purpose programs. Conversation with computers; question-answering programs. Trainable pattern classifiers-linear, piecewise linear, quadratic, 'O', and multilayer machines. Statistical decision theory, decision functions, liklihood ratios; mathematical taxonomy, cluster detection. Neural models, computational properties of neural nets, processing of sensory information, representative conceptual models of the brain.

CMSC 733 Computer Processing of Pictorial Information (3) Prerequisite: CMSC 420. Input, output, and storage of pictorial information. Pictures as information sources, efficient encoding sampling, quantization, approximation. Position-invariant operations on pictures, digital and optical implementations, the pax language, applications to matched and spatial frequency filtering. Picture quality, 'image enhancement' and 'image restoration'. Picture properties and pictorial pattern recognition. Processing of complex pictures; 'figure' extraction, properties of figures. Data structures for pictures description and manipulation; 'picture languages'. Graphics systems for alphanumeric and other symbols, line drawings of two- and three-dimensional objects, cartoons and movies.

CMSC 737 Topics in Information Science (3) Prerequisite: Permission of the instructor. This is the same course as LBSC 721. Definition of information science, relation to cybernetics and other sciences, systems analysis, information, basic constraints on information systems, processes of communication, classes and their use, optimalization and mechanization.

CMSC 740 Automata Theory (3) Prerequisite: CMSC 640. This is the same course as ENEE 652. Introduction to the theory of abstract mathematical machines. Structural and behavioral classification of automata. Finite-state automata; theory of regular sets. Pushdown automata. Linear-bounded automata. Finite transducers. Turing machines; universal turing machines.

CMSC 745 Theory of Formal Languages (3) Prerequisite: CMSC 640. Formal grammars; syntax and semantics. Post productions; Markov algorithms. Finite-state languages, parsing, trees, and ambiguity. Theory of regular sets. Context-free languages; pushdown automata. Context-sensitive languages; linear-bounded automata. Unrestricted rewriting systems; turing machines. Closure properties of languages under operations. Undecidability theorems.

CMSC 750 Theory of Computability (3) Prerequisite: CMSC 640. Algorithms; Church's thesis. Primitive recursive functions; Godel numbering. General and partial recursive functions. Turing machines; Turings' thesis. Markov algorithms. Church's lamda calculus. Grzegorczyk hierarch; Peter hierarchy. Relative recursiveness. Word problems, Post's correspondence problem.

CMSC 755 Theories of Information (3) Prerequisite: CMSC 620 and STAT 401. Mathematical and logical foundations of existing theories of information. Topics include Fisher's theory of statistical information, Kullback and Leibler's theory of statistical information, Shannon's theory of selective information, and Carnap and Bar-Hillel's theory of semantic information. The similarities and differences of these and other theories are treated.

CMSC 770 Advanced Linear Numerical Analysis (3) Prerequisite: MAPL 470, 471 and MATH 405 or MATH 474; or consent of instructor. Advanced topics in numerical linear algebra, such as dense Eigenvalue problems, sparse elimination, iterative methods, and other topics. (Same as MAPL 600.)

CMSC 772 Numerical Solution of Nonlinear Equations (3) Prerequisite: MAPL 470, 471 and MATH 410; or consent of instructor. Numerical solution of nonlinear equations in one and several variables. Existence questions. Minimization methods. Selected applications. (Same as MAPL 604.)

CMSC 780 Computer Applications to the Physical Sciences (3) Prerequisites: CMSC 210, STAT 400, and a graduate course in physical science. Applications of computers to numerical calculation, data reduction, and modeling in the physical sciences. Stress will be laid on the features of the applications which have required techniques not usually considered in more general contexts.

CMSC 782 Modeling and Simulation of Physical Systems (3) Prerequisites: CMSC 210 and STAT 401. Monte-Carlo and other methods of investigating models of interest to physical scientists. Generation and testing of random numbers. Probabilistic, deterministic and incomplete models.

CMSC 798 Graduate Seminar in Computer Science (1–3)

CMSC 799 Master's Thesis Research (1–6)

CMSC 818 Advanced Topics in Computer Systems (1–3) Prerequisite: Permission of instructor. Advanced topics selected by the faculty from the literature of computer systems to suit the interest and background of students. May be repeated for credit.

CMSC 828 Advanced Topics in Information Processing (1–3) Prerequisite: Permission of instructor. Advanced topics selected by the faculty from the literature of information processing to suit the interest and background of students. May be repeated for credit.

CMSC 838 Advanced Topics in Programming Languages (1–3) Prerequisite: Permission of instructor. Advanced topics selected by faculty from the literature of programming languages to suit the interest and background of students. May be repeated for credit.

CMSC 840 Advanced Automata Theory (3) Prerequisite: CMSC 740. Advances and innovations in automata theory. Variants of elementary automata; multitape, multihead, and multidimensional machines. Counters and stack automata. Wang machines; Shepherdson-Sturgis machines. Recursive hierarchies. Effective computability; relative uncomputability. Probabilistic automata.

CMSC 858 Advanced Topics in Theory of Computing (1–3) Prerequisite: Permission of instructor. Advanced topics selected by the faculty from the literature of theory of computing to suit the interest and background of students. May be repeated for credit.

CMSC 878 Advanced Topics in Numerical Methods (1–3) Prerequisite: Permission of instructor. Advanced topics selected by the faculty from the literature of numerical methods to suit the interest and background of students. May be repeated for credit.

CMSC 898 Advanced Topics in Applications (1–3) Prerequisite: Permission of instructor. Advanced topics selected by the faculty from the literature of applications of Computer Science to suit the interest and background of students. May be repeated for credit.

CMSC 899 Doctoral Dissertation Research (1–8) (1–8)

Counseling and Personnel Services Program

Professor and Chairman: Marx
Professors: Byrne, Magoon[1,2], Pumroy[1], Schlossberg
Associate Professors: Allan, Birk[2], Greenberg, Knefelkamp, Lawrence, Leonard Medvene[2], Power, Ray, Rhoads, Westbrook
Assistant Professors: Boyd, Celotta, Dagnato, Freeman, Hoffman, Libby, McMullan, Spokane, Teglasi, Thomas,

[1]Joint appointment with Psychology
[2]Joint appointment with Counseling Center.

Historically, the programs of the Department of Counseling and Personnel Services have been responsive to societal needs in providing leadership in the training of specialized personnel service workers. The programs are designed for the preparation of professionals who serve in a variety of social settings including schools, colleges, rehabilitative agencies, government agencies and other community agencies. These professionals may serve one of several roles either at the practitioner's level or at an advanced level of leadership, supervision and research. Programs of preparation for practitioners are offered at the master's and Advanced Graduate Specialist level while the advanced offerings for researchers, supervisors, and personnel administrators are conducted at the doctoral level. The master's and Advanced Graduate Specialist programs are offered among the following six specialty programs within the Department.

1) The Elementary School Counseling Specialty Program prepares the student as a child development consultant, individual and group counselor and coordinator of pupil services. 2) The Secondary School Counseling Program prepares the student to serve as a member of a human resources team in individual and group counseling, as information specialist regarding personal, social, educational and vocational matters, and pupil personnel program coordination. 3) The School Psychology Program prepares the student to be certified as a school psychologist where his principal functions are to assess psychological conditions and devise intervention strategies to enhance the learning of pupils. 4) The College Student Personnel Specialty Program prepares specialists at the higher education level in two areas of concentration: college counseling and Student Personnel Administration which includes areas such as Student Development, Student Union, Housing, Admissions, Placement, Deans of Students and Vice Presidents of Student Affairs. 5) The Community Counseling Specialty Program provides three emphases within the program: Career development and vocational counseling, personal-social counseling and community mental health consultation, and adult counseling. 6) The Rehabilitation Counseling Specialty Program prepares counselors to work with mentally, emotionally, socially and physically handicapped persons in public and private agencies.

The doctoral programs in Counseling and Personnel Services are designed to prepare students to achieve exceptional competence in the areas of research, theory, and practice related to personnel services. Graduates typically assume positions of leadership, research or supervision of personnel services in public

units such as large school systems, universities, or state rehabilitation and community agencies; as professors in personnel service programs; as counselors in higher education institutions. The program leading to the Doctor of Philosophy degree, has as its major emphasis theory and research in the behavioral sciences and applied fields. The primary thrust at the master's and Advanced Graduate Specialist levels is upon excellence in practice.

Admission and Degree Information

Admission to these programs is not only based on meeting minimum requirements, but is also competitively based on staff resources available.

The requirements for the master's and Advanced Graduate Specialist's diplomas are spelled out for each of the six specialty areas. Write or call for the specialty area brochure(s) which interest you. (301) 454–2026.

The doctoral program of studies is developed with an advisor. The single required course is Advanced Statistics. There are no language requirements for the Ph.D. degree.

Courses

EDCP 410 Introduction to Counseling and Personnel Services (3) Presents principles and procedures, and examines the function of counselors, psychologists in schools, school social workers, and other personnel service workers.

EDCP 411 Mental Hygiene (3) The practical application of the principles of mental hygiene to classroom problems.

EDCP 413 Behavior Modification (3) Knowledge and techniques of intervention in a variety of social situations, including contingency contracting and time out will be acquired.

EDCP 414 Principles of Behavior (3) Development of student proficiency in analyzing complex patterns of behavior on the basis of empirical evidence.

EDCP 415 Behavior Mediation (3) Prerequisite: EDCP 414. Basic principles of human behavior will be reviewed and application of these principles will be implemented under supervision.

EDCP 417 Group Dynamics and Leadership (3) The nature and property of groups, interaction analysis, developmental phases, leadership dynamics and styles, roles of members and interpresonal communications. Two hours of lecture discussion and two hours of laboratory per week, laboratory involves experimental based learning.

EDCP 420 Education and Racism (3) Strategy development for counselors and educators to deal with problems of racism.

EDCP 460 Introduction to Rehabilitation Counseling (3) Introductory course for majors in rehabilitation counseling, social work, psychology, or education who desire to work professionally with physically or emotionally handicapped persons.

EDCP 470 Introduction to Student Personnel (3) Prerequisite: Consent of instructor. A systematic analysis of research and theoretical literature on a variety of major problems in the organization and administration of student personnel services in higher education. Included will be discussion of such topics as the student personnel philosophy in education, counseling services, discipline, housing, student activities, financial aid, health, remedial services, etc.

EDCP 489 Field Experience in Counseling and Personnel Services (1–4) Prerequisites: At least six semester hours in education at the University of Maryland plus such other prerequisites as may be set by the major area in which the experience is to be taken. Planned field experience may be provided for selected students who have had teaching experience and whose application for such field experience has been approved by the education faculty. Field experience is offered in a given area to both major and nonmajor students. Note: The total number of credits which a student may earn in EDCP 489, 888, and 889 is limited to a maximum of 20 semester hours.

EDCP 498 Special Problems in Counseling and Personnel Services (1–3) Prerequisite: Consent of instructor. Available only to major students who have formal plans for individual study of approved problems.

EDCP 499 Workshops, Clinics, Institutes (1–6) The maximum number of credits that may be earned under this course symbol toward any degree is six semester hours; the symbol may be used two or more times until six semester hours have been reached. The following type of educational enterprise may be scheduled under this course heading: workshops conducted by the department of counseling and personnel services (or developed cooperatively with other departments, colleges and universities) and not otherwise covered in the present course listing; clinical experiences in counseling and testing centers, reading clinics, speech therapy laboratories, and special education centers; institutues developed around specific topics or problems and intended for designated groups.

EDCP 605 Issues in Counseling Adults (3) Theoretical approaches to adult development. The scope and variety of settings (industry, education, government) in which programs of adult counseling and guidance take place, and the nature of such programs.

EDCP 611 Occupational Choice Theory and Information (3) Research and theory related to occupational and educational decisions; programs of related information and other activities in occupational decision.

EDCP 614 Personality Theories in Counseling and Personnel Services (3) Examination of constructs and research relating to major personality theories with emphasis on their significance for working with the behaviors of individuals.

EDCP 615 Cases in Appraisal (3) Prerequisite: EDMS 446 or EDMS 451. Collecting and interpreting nonstandardized pupil appraisal data, synthesis of all types of data through case study procedures.

EDCP 616 Counseling—Theoretical Foundations and Practice (3) Prerequisite: EDCP 615. Exploration of learning theories as applied to counseling in school, and practices which stem from such theories.

EDCP 617 Group Counseling (3) Prerequisite: EDCP 616. A survey of theory, research and practice of group counseling and psychotherapy with an introduction to growth groups and the laboratory approach, therapeutic factors in groups, composition of therapeutic groups, problem clients, therapeutic techniques, research methods, theories, ethics and training of group counselors and therapists.

EDCP 619 Practicum in Counseling (2–6) Prerequisites: EDCP 616 and permission of instructor. Sequence of supervised counseling experiences of increasing complexity. Limited to eight applicants in advance. Two hours class plus laboratory.

EDCP 626 Group Counseling Practicum (3) Prerequisite: EDCP 617, EDCP 619, and consent of instructor. A supervised field experience in group counseling.

EDCP 627 Process Consultation (3) Prerequisite: Graduate course in group process. Study of case consultation, systems consultation, mental health consultation and the professional's role in systems intervention strategies.

EDCP 633 Diagnostic Appraisal of Children I (4) Assessment of development, emotional and learning problems of children in schools. Practicum experience.

EDCP 634 Diagnostic Appraisal of Children II (4) Prerequisite: EDCP 633. Assessment of development, emotional, and learning problems of adolescents in schools. Practicum experience.

EDCP 635 Therapeutic Techniques and Classroom Management I (3) Prerequisite: EDCP 414. Diagnosis and treatment of problems presented by teachers and parents. Practicum experience.

EDCP 636 Therapeutic Techniques and Classroom Management II (3) Prerequisite: EDCP 635. The objective of this course is to understand and to treat children's problems. The focus is primarily on the older child in secondary school and the orientation is essentially behavioral. Practicum experience will be provided.

EDCP 645 Counseling in Elementary Schools (3) Prerequisite: EDCP 615 or consent of instructor. Counseling theory and practices as related to children. Emphasis will be placed on an awareness of the child's total behavior as well as on specific methods of communicating with the child through techniques of play interviews, observations, and the use of nonparametric data.

EDCP 655 Organization and Administration of Personnel Services (2) Prerequisite: EDCP 619 or permission of instructor. Exploration of Personnel services programs and implementing personnel services practices.

EDCP 656 Counseling and Personnel Services Seminar (2) Prerequisite: Advanced standing. Examination of issues that bear on professional issues such as ethics, interprofessional relationships and research.

EDCP 661 Psycho-Social Aspects of Disability (3) Prerequisite: EDCP 460 or consent of instructor. This course is part of the core curriculum for rehabilitation counselors. It is designed to develop an understanding of the nature and importance of the personal and psycho-social aspects of adult disability.

EDCP 662 Psychiatric Aspects of Disability I (3) Prerequisite: EDCP 460 or equivalent and consent of instructor. Part of core curriculum in rehabilitation counseling. It is designed to develop an understanding of the rehabilitation process, clients served, and skills and attitudes necessary for working effectively with the physically disabled.

EDCP 663 Psychiatric Aspects of Disability II (3) Prerequisite: EDCP 460 or equivalent and consent of instructor. Part of core curriculum in rehabilitation counseling. The psychiatric rehabilitation client: understanding his needs, treatment approaches available, and society's reaction to the client.

EDCP 668 Special Topics in Rehabilitation (1–6) Prerequisite: Permission of the instructor. Repeatable to a maximum of six hours.

EDCP 716 Advanced Counseling Theory Seminar (3) Prerequisite: Master's degree in counseling, or instructor's permission. Systematic investigation of methods of theory analysis and their application to counseling theory.

EDCP 718 Advanced Seminar in Group Processes (2–6) Prerequisites: EDCP 626. Repeatable to a maximum of six credits.

EDCP 735 Seminar in Rehabilitation Counseling (2) This course is part of the core curriculum for rehabilitation counselors. It is designed to provide the advanced rehabilitation counseling student with a formal seminar to discuss, evaluate and attempt to reach personal resolution regarding pertinent professional problems and issues in the field.

EDCP 771 The College Student (3) A demographic study of the charactenstics of college students as well as a study of their aspirations, values, and purposes.

EDCP 776 Modification of Human Behavior: Laboratory and Practicum (3) Prerequisite: Permission of instructor. Individual and group supervised introduction to intake and counseling relationships.

EDCP 777 Modification of Human Behavior—Laboratory and Practicum (3) Prerequisite: EDCP 776 and permission of instructor. Continuation of EDCP 776. Further experience under direct supervision of more varied forms of counseling relationships.

EDCP 778 Seminar in Student Personnel (2–6) An intensive study of the various student personnel functions. A means to integrate the knowledge from various fields as they relate to student personnel administration.

EDCP 788 Advanced Practicum in Counseling (1–6) Prerequisite: Permission of instructor, previous practicum experience. Individual supervision of counseling, and group consultation. Repeatable to a maximum of six credits.

EDCP 789 Advanced Topics in Counseling and Personnel Services (1–6) Repeatable to a maximum of 6 credits.

EDCP 798 Special Problems in Counseling and Personnel Services (1–6) Master's AGS, or doctoral candidates who desire to pursue special research problems under the direction of their advisers may register for credit under this number.

EDCP 799 Master's Thesis Research (1–6) Registration required to the extent of six hours for master's thesis.

EDCP 888 Apprenticeship in Counseling and Personnel Services (1–8) Apprenticeships in the major area of study are available to selected students whose

application for an apprenticeship has been approved by the education faculty. Each apprentice is assigned to work for at least a semester full-time or the equivalent with an appropriate staff member of a cooperating school, school system, or educational institution or agency. The sponsor of the apprentice maintains a close working relationship with the apprentice and the other persons involved. Prerequisites: teaching experience, a master's degree in education, and at least six semester hours in education at the University of Maryland. Note: The total number of credits which a student may earn in EDCP 489, 888, and 889 is limited to a maximum of twenty (20) semester hours.

EDCP 889 Internship in Counseling and Personnel Services (3–8) Internships in the major area of study are available to selected students who have teaching experience. The following groups of students are eligible: (a) Any student who has been advanced to candidacy for the doctor's degree; and (b) Any student who receives special approval by the education faculty for an internship, provided that prior to taking an internship, such student shall have completed at least 60 semester hours of graduate work, including at least six semester hours in education at the University of Maryland. Each intern is assigned to work on a full-time basis for at least a semester with an appropriate staff member in a cooperating school, school system, or educational institution or agency. The internship must be taken in a school situation different from the one where the student is regularly employed. The intern's sponsor maintains a close working relationship with the intern and the other persons involved. Note: The total number of credits which a student may earn in EDCP 489, 888, and 889 is limited to a maximum of twenty (20) semester hours.

EDCP 899 Doctoral Dissertation Research (1–8) Registration required to the extent of 6–9 hours for an Ed.D. project and 12–18 hours for a Ph.D. dissertation.

Criminal Justice and Criminology Program

(Institute of Criminal Justice and Criminology)
Acting Director: Ingraham
Professor Emeritus: Lejins
Associate Professors: Ingraham, Maida, Tennyson
Assistant Professors: B. Johnson, McKenzie, Minor

The Program of graduate study leading to a Master of Arts and Ph.D. degree in the area of Criminal Justice and Criminology is intended to prepare students for research, teaching and professional employment in the operational agencies in the field of criminal justice. This program combines an intensive background in a social science discipline such as sociology, psychology, public administration, etc., with graduate-level study of selected aspects of the criminal justice field.

Admission and Degree Information

In addition to the general Graduate School requirements, special admission requirements include the Graduate Record Examination Aptitude Test, a major in a social science discipline, and 9 hours of course work in the appropriate area of criminal justice. For the M.A. applicant, the undergraduate social science major must have included at least one course each in theory, statistics and research methods. The Ph.D. applicant must have completed two statistics, two research methods and two theory courses, one of each being at the master's-level. Admission to the Ph.D. program presupposes completion of the M.A. degree. At the discretion of the Graduate Admissions Committee of the Institute, deficiencies in some of the above areas may be made up by noncredit work at the beginning of the program.

Students enrolled in the M.A. program have two options: a Criminology option and a Criminal Justice option. The general plan of study for both options, totaling to 30 semester hours, is as follows: 1) Three social science courses on an appropriate level in theory, methodology, and statistics. 2) Three appropriate-level courses in Criminology or Law Enforcement, depending upon the option. Two of these must be at the 600 level or above. One of these should be a general seminar dealing with the overall field of criminal justice (LENF 600). 3) Two elective courses. 4) Tutorial courses may be taken only as elective courses. 5) The student has a choice between: a) an M.A. degree with an M.A. thesis, b) an M.A. degree without thesis, but with some additional requirements.

For completion of the Ph.D. degree, in addition to the general Graduate School Ph.D. requirements, competence in the theory of at least one social science discipline, in research methodology and in quantitative techniques is expected, as well as competence in the general theory of the criminal justice field and in the specialization area selected by the student. The necessary coursework is determined on the basis of the student's previous preparation, needs, and interests. The candidate is required to pass comprehensive examinations.

Financial Assistance

Graduate teaching assistantships are available on a competitive basis. Further, graduate research assistantships are sometimes available for graduate students to participate in research projects directed by faculty members and funded by outside sources.

Additional Information

A brochure describing the Institute of Criminal Justice and Criminology and its programs is available upon request. Inquiries should be directed to: Graduate Program Coordinator

Courses

Crlminology

CRIM 432 Law of Corrections (3) Prerequisite: LENF 230 or 234 and CRIM 220. A review of the law of criminal corrections from sentencing to final release or release on parole. Probation, punishments, special treatments for special offenders, parole and pardon, and the prisoner's civil rights are also examined.

CRIM 450 Juvenile Delinquency (3) Prerequisite: SOCY 100. Juvenile delinquency in relation to the general problem of crime; analysis of factors underlying juvenile delinquency; treatment and prevention.

CRIM 451 Crime and Delinquency Prevention (3) Prerequisites: CRIM 220 or CRIM 450 or consent of instructor. Methods and programs in prevention of crime and delinquency.

CRIM 452 Treatment of Criminals and Delinquents in the Community (3) Prerequisite: CRIM 220 or CRIM 450 or consent of instructor. Analysis of the processes and methods in the modification of criminal patterns of behavior in a community setting.

CRIM 453 Institutional Treatment of Criminals and Dellnquents (3) Prerequisite: CRIM 220 or CRIM 450 or consent of instructor. History, organization and functions of penal and correctional institutions for adults and juveniles.

CRIM 454 Contemporary Criminological Theory (3) Prerequisite: CRIM 220, CRIM 450, and CRIM 451 or CRIM 452 or CRIM 453. Brief historical overview of criminological theory up to the 50's. Deviance. Labeling. Typologies. Most recent research in criminalistic subcultures and middle class delinquency. Recent proposals for 'decriminalization'.

CRIM 455 Psychology of Criminal Behavior (3) Prerequisites: CRIM 220 or equivalent and PSYC 331 or equivalent. Psychological, environmental, and personality factors which influence criminal behavior. Biophysiology and crime, stress and crime, maladjustment patterns, psychoses, personality disorders, aggression and violent crime, sex-motivated crime and sexual deviations, alcohol and drug abuse, and criminal behavior.

CRIM 498 Selected Topics in Criminology (3) Topics of special interest to advanced undergraduates in criminology. Such courses will be offered in response to student request and faculty interest. No more than six credits may be taken by a student in selected topics.

CRIM 610 Research Methods in Criminal Justice and Criminology (3) Prerequisite: Completion of research methods and statistics requirements for the M.A. degree. Examination of special research problems and techniques.

CRIM 650 Advanced Criminology (3) First semester. Survey of the principal issues in contemporary criminological theory and research.

CRIM 651 Seminar in Criminology (3) Second semester.

CRIM 652 Seminar in Juvenile Delinquency (3) First semester.

CRIM 653 Crime and Delinquency as a Community Problem (3) Second semester. An intensive study of selected problems in adult crime and juvenile delinquency in Maryland.

CRIM 654 History of Criminological Thought (3) Prerequisite: CRIM 454 or its equivalent. A study of the development of criminological thought from antiquity to the present.

CRIM 699 Special Criminological Problems (3)

CRIM 799 Master's Thesis Research (1–6)

CRIM 899 Doctoral Dissertation Research (1–8) Doctoral dissertation research in criminal justice and criminology.

Law Enforcement

LENF 444 Advanced Law Enforcement Administration (3) Prerequisite: LENF 340 or consent of instructor. The structuring of manpower, material, and systems to accomplish the major goals of social control. Personnel and systems management. Political controls and limitations on authority and jurisdiction.

LENF 455 Dynamics of Planned Change in Criminal Justice I (3) Prerequisite: Consent of instructor. An examination of conceptual and practical issues related to planned change in criminal justice. Emphasis on the development of innovative ideas using a research and development approach to change.

LENF 456 Dynamics of Planned Change in Criminal Justice II (3) Prerequisite: LENF 455 or consent of instructor. An examination of conceptual and practical issues related to planned change in criminal justice. Emphasis on change strategies and tactics which are appropriate for criminal justice personnel in entry level positions.

LENF 462 Special Problems in Security Administration (3) Prerequisites: LENF 360 and consent of instructor. An advanced course for students desiring to focus on specific concerns in the study of private security organizations; business intelligence and espionage; vulnerability and criticality analyses in physical security; transportation, banking, hospital and military security problems; uniformed security forces; national defense information; and others.

LENF 498 Selected Topics in Criminal Justice (1–6) Prerequisite: Consent of instructor. Supervised study of a selected topic to be announced in the field of criminal justice. Repeatable to a maximum of six credits.

LENF 600 Criminal Justice (3) Prerequisites: Admission to the graduate program in criminal justice or consent of instructor. Current concept of criminal justice in relationship to other concepts in the field. Historical perspective. Criminal justice and social control. Operational implications. Systemic aspects. Issues of evaluation.

LENF 630 Seminar in Criminal Law and Society (3) Prerequisite: LENF 230 or its equivalent and a course in introductory criminology. The criminal law is studied in the context of general studies in the area of the sociology of law. The evolution and social and psychological factors affecting the formulation and administration of criminal laws are discussed. Also examined is the impact of criminal laws and their sanctions on behavior in the light of recent empirical evidence.

LENF 640 Seminar in Criminal Justice Administration (3) Prerequisites: One course in the theory of

groups or organizations, one course in administration; or consent of instructor. Examination of external and internal factors that currently impact on police administration. Intra-organizational relationships and policy formulation; the conversion of inputs into decisions and policies. Strategies for formulating, implementing and assessing administrative decisions.

LENF 699 Special Problems in Criminal Justice (1–3) Prerequisite: Consent of instructor. Supervised study of a selected problem in the field of criminal justice. Repeatable to a maximum of 6 credits.

LENF 720 Criminal Justice System Planning (3) Prerequisites: One course in criminal justice and one course in research methodology. System theory and method; examination of planning methods and models based primarily on a systems approach to the operations of the criminal justice system.

LENF 799 Master's Thesis Research (1–6)

Early Childhood-Elementary Education Program

Visiting Associate Professor and Interim Chairman: YFF
Professors: Ashlock, Duffey O'Neill, Roderick, Sublett, Weaver, R. Wilson
Associate Professors: Amershek, Church, Eley, Heidelbach, Herman, Jantz, Johnson, Schumaker, Seefeldt, Williams.
Assistant Professors: Cole, Gambrell, Garner, Heathington Knifong, Lee, Madison, Saracho, Schumacher

Graduate programs leading to M.A., M.Ed., Ed.D., and Ph.D. degrees in the Department of Early Childhood-Elementary Education are designed to prepare teachers, curriculum specialists, supervisors, administrators, and higher education instructors to function effectively in leadership positions in programs for children.

Students have opportunities to specialize in any of the following areas: early childhood education, elementary education, reading science education, mathematics education, language arts, social studies education, or nursery-kindergarten education.

Admission and Degree Information

Masters Degree programs average 30–36 semester hours. Ed.D. and Ph.D. programs average 90 semester hours, including work at the master's level. All applicants must submit the Miller Analogy Test score as prerequisite to admission.

EDEL 500 and 501, qualifying courses for which no graduate credit is offered, may be required of some students.

Programs, particularly at the doctoral level, are individualized to reflect the students' backgrounds and to meet their particular career goals. Regular counseling with an advisor is an important aspect of each program. An effort is made to ascertain that graduate programs include both theory and practicum, professional work and academic courses.

There is a comprehensive examination near the completion of work at the master's level. The Ph.D. program includes a preliminary examination after approximately 12 semester hours of work and a comprehensive examination near the completion of the program.

Facilities and Special Resources

Special facilities for graduate study include the Reading Center, the Science Teaching Center, the Arithmetic Center, the Teacher Education Centers in local schools, and the Center for Young Children.

Financial Assistance

The Department is able to give financial aid, in the form of graduate assistantships, to a limited number of students of proven ability who have had public school teaching experience.

Courses

EDEL 401 Science in Early Childhood Education (3) Designed primarily to help in-service teachers, Nursery School through Grade 3, to acquire general science understandings and to develop teaching materials for practical use in classrooms. Includes experiments, demonstrations, constructions, observations, field trips and use of audio-visual materials. The emphasis is on content and method related to science units in common use in Nursery School through Grade 3. Offered during summer sessions and in off-campus programs taught through University College. Ordinarily there is no field placement.

EDEL 402 Science in the Elementary School (3) Designed primarily to help in-service teachers, Grades 1–6, to acquire general science understandings and to develop teaching materials for practical use in classrooms. Includes experiments, demonstrations, constructions, observations, field trips and use of audio-visual materials. The emphasis is on content and method related to science units in common use in Grades 1–6. Offered during summer sessions and in off-campus programs taught through University College. Ordinarily there is no field placement.

EDEL 404 Language Arts in Early Childhood Education (3) Teaching of spelling, handwriting, oral and written expression and creative expression. Designed primarily for in-service teachers, Nursery School through Grade 3. Offered during summer sessions and in off-campus programs taught through University College. Ordinarily, there is no field placement.

EDEL 405 Language Arts in the Elementary School (3) Teaching of spelling, handwriting, oral and written expression and creative expression. Designed primarily for in-service teachers, Grades 1–6. Offered during summer sessions and in off-campus programs taught through University College. Ordinarily there is no field placement.

EDEL 406 Social Studies in Early Childhood Education (3) Consideration given to curriculum, organization and methods of teaching, evaluation of newer materials and utilization of environmental resources. Designed for in-service teachers, Nursery School through Grade 3. Offered during summer sessions and in off-campus programs taught through University College. Ordinarily there is no field placement.

EDEL 407 Social Studies in the Elementary School (3) Consideration given to curriculum, organization and methods of teaching, evaluation of newer materials and utilization of environmental resources. Designed for in-service teachers, Grades 1–6. Offered during summer session and in off-campus programs taught through University College. Ordinarily there is no field placement.

EDEL 410 The Child and the Curriculum—Early Childhood (3) Relationship of the school curriculum, Nursery School through Grade 3, to child growth and development. Recent trends in curriculum organization; the effect of environment on learning; readiness to learn; and adapting curriculum content and methods to maturity levels of children. Designed for in-service teachers, Nursery School through Grade 3. Offered during summer sessions and in off-campus programs taught through University College. Ordinarily there is no field placement.

EDEL 411 The Child and the Curriculum—Elementary (3) Relationship of the school curriculum, Grades 1–6, to child growth and development. Recent trends in curriculum organization; the effect of environment on learning; readiness to learn; and adapting curriculum content and methods to maturity levels of children. Designed for in-service teachers, Grades 1–6. Offered during summer sessions and in off-campus programs taught through University College. Ordinarily there is no field placement.

EDEL 412 Art in the Elementary School (3) Concerned with art methods and materials for elementary schools. Includes laboratory experiences with materials appropriate for elementary schools.

EDEL 413 Mathematics in Early Childhood Education (3) Prerequisite, MATH 210 or equivalent. Emphasis on materials and procedures which help pupils sense arithmetic meanings and relationships. Designed to help in-service teachers, nursery school through Grade 3, gain a better understanding of the number system and arithmetical processes. Offered during summer sessions and in off-campus programs taught through University college. Ordinarily there is no field placement.

EDEL 414 Mathematics in the Elementary School (3) Prerequisite, MATH 210 or equivalent. Emphasis on materials and procedures which help pupils sense arithmetic meanings and relationships. Designed to help in-service teachers, Grades 1–6, gain a better understanding of the number system and arithmetical processes. Offered during summer sessions and in off-campus programs taught through University College. Ordinarily there is no field placement.

EDEL 415 Diagnosis and Treatment of Learning Disabilities in Mathematics I (3) Prerequisite: EDEL 351 or equivalent and approval of instructor. Diagnosis and treatment of disabilities in mathematics. Theoretical models, specific diagnostic and instructional techniques and materials for working with children in both clinical and classroom settings. Practice using techniques by conducting case studies with children previously diagnosed as primarily corrective rather than serverely disabled. Clinic hours to be arranged.

416 The Mathematics Laboratory (3) Prerequisite: EDEL 351 or equivalent, or consent of the instructor. The definition, design, and uses of an elementary school mathematics laboratory. Laboratory visitations. The design of instructional activities and field-test activities with children.

EDEL 417 Social Studies and Multiethnic Education (3) Prerequisites: A preservice social studies methods course or permission of the instructor. Seminars will be held relating to general social science principles that are applicable to multiethnic education as a component of social studies instruction. Cultural experiences arranged on an independent basis for each participant.

EDEL 424 Literature for Children and Young People, Advanced (3) Development of literary matenals for children and young people. Timeless and ageless books, and outstanding examples of contemporary publishing. Evaluation of the contributions of individual authors and illustrators and children's book awards.

EDEL 425 The Teaching of Reading—Early Childhood (3) Concerned with the fundamentals of developmental reading instruction, including reading readiness, use of experience stories, procedures in using basal readers, the improvement of comprehension, teaching reading in all areas of the curriculum, uses of children's literature, the program in word analysis, and procedures for determining individual needs. Designed for in-service teachers, Nursery School through Grade 3. Offered during summer sessions and in off-campus programs taught through University College. Ordinarily, there is no field placement.

EDEL 426 The Teaching of Reading—Elementary (3) Concerned with the fundamentals of developmental reading instruction, including reading readiness, use of experience stories, procedures in using basal readers, the improvement of comprehension, teaching reading in all areas of the curriculum, uses of children's literature, the program in word analysis, and procedures for determining individual needs. Designed for in-service teachers, Grades 1–6. Offered during summer sessions and in off-campus programs taught through University College. Ordinarily, there is no field placement.

EDEL 430 Corrective-Remedial Reading Instruction (3) Prerequisite: EDEL/EDSE 427 or equivalent, and consent of the department. For teachers, supervisors, and administrators who wish to identify and assist pupils with reading difficulties Concerned with diagnostic techniques, instructional matenals and teaching procedures useful in the regular classroom.

EDEL 431 Laboratory Practices in Reading (3) Prerequisite, EDEL 430. A laboratory course in which each student has one or more pupils for analysis and instruction. At least one class meeting per week to diagnose individual cases and to plan instruction

EDEL 488 Special Topics in Elementary Education (1–3) Prerequisite, Consent of instructor. Special treatment of current topics and issues in Elementary Education. Repeatable to maximum of 6 credits, provided content is different.

EDEL 489 Field Experience in Education (1–4) Prerequisites, At least six semester hours in Education at

the University of Maryland plus such other prerequisites as may be set by the major area in which the experience is to be taken. Planned field experience may be provided for selected students who have had teaching experience and whose application for such field experience has been approved by the Education faculty. Field experience is offered in a given area to both major and nonmajor students. Note—The total number of credits which a student may earn in EDEL 489, 888, and 889 is limited to a maximum of 20 semester hours.

EDEL 498 Special Problems in Education (1–3) Prerequisite, Consent of instructor. Available only to mature students who have definite plans for individual study of approved problems.

EDEL 499 Workshops, Clinics, and Institutes (1–6) The maximum number of credits that may be earned under this course symbol toward any degree is six semester hours; the symbol may be used two or more times until six semester hours have been reached. The following types of educational enterprise may be scheduled under this course heading: workshops conducted by the College of Education (or developed cooperatively with other colleges and universities) and not otherwise covered in the present course listing; clinical experiences in pupil-testing centers, reading clinics, speech therapy laboratories, and Special Education centers; institutes developed around specific topics or problems and intended for designated groups such as school superintendents, principals and supervisors.

EDEL 500 Education of the Young Child (3) Prerequisites: A baccalaureate degree and consent of the department. An initial course for persons entering graduate study in Early Childhood Education, to provide a foundation for further graduate study or a supplement to other areas. Intensive study of current education programs, teacher roles, and planning, staffing, and organizing for children's learning needs. Not appicable towards graduate degrees.

EDEL 501 Materials and Practices in Early Childhood Education (3) Prerequisites: A baccalaureate degree and consent of the department. An overview of practices and media available for innovative approaches in Early Childhood programs, including diagnostic and prescriptive techniques. Not applicable toward graduate degrees.

EDEL 600 Seminar in Elementary Education (3) Primarily for individuals who wish to write seminar papers. Prerequisite, At least 12 hours of graduate work in education.

EDEL 601 Problems in Teaching Science in Elementary Schools (3) Prerequisite: EDEL 353 or 402 or consent of the instructor. Analysis of the teaching of science to children through (1) the identification of problems to teaching science, (2) the investigation and study of research reports related to the identified problems, and (3) the hypothesizing of methods for improving the effectiveness of science education for children.

EDEL 605 Problems of Teaching Language Arts in Elementary Schools (3) Prerequisite: EDEL 404 or approval of instructor. This course is designed to allow each student an opportunity (1) to analyze current issues, trends, and problems in language-arts instruction in terms of research in fundamental educational theory and the language arts, and (2) to use this analysis in effecting changes in methods and materials for classroom instruction.

EDEL 607 Problems of Teaching Social Studies in Elementary Schools (3) Prerequisite, EDEL 406 or approval of instructor. An examination of current literature and research reports in the social sciences and in social studies curriculum design and instruction, with an emphasis on federally-sponsored projects as well as programs designed for urban children.

EDEL 613 Theoretical and Research Foundations of Elementary School Mathematics (3) Prerequisite: EDEL 351 or equivalent, or permission of the instructor. Theoretical and research literature interrelating mathematics education with psychology, sociology, philosophy, and history. Evaluation of the influence of this literature on research, teacher preparation, and mathematics instruction in schools.

EDEL 614 Elementary School Mathematics Curricula (3) Prerequisite, EDEL 314 or equivalent and approval of instructor. Critical evaluation of past and present curricular projects, experimental programs, and instructional materials. Design and implementation of elementary school mathematics curricula.

EDEL 615 Diagnosis and Treatment of Learning Disabilities in Mathematics II (3) Prerequisite, EDEL 415 or equivalent and approval of instructor. Diagnosis and treatment of severe learning disabilities in elementary school mathematics. Theoretical models, relevent research and specific techniques appropriate for accessing the interaction of subject matter, organismic, and instructional variables will be developed. Clinic hours for case study work to be arranged.

EDEL 618 Practium in Diagnoses and Treatment of Learning Disabilities in Mathematics (3) Prerequisite: EDEL 615 or equivalent and approval of instructor. Supervised clinical research studies with children experiencing learning difficulties in Mathematics. Extension of diagnostic treatment and reporting procedures developed in EDEL 415 and 615. Course may be repeated to a maximum of 6 hours.

EDEL 620 Teaching Children's Literature in the Elementary Classroom (3) Issues and trends in children's literature with emphasis on implications in classroom settings. Contemporary social conditions and problems, trends in publishing, advertising, censorship, media adaptation, and reading habits.

EDEL 624 Reading Diagnostic Assessment and Prescription (3) Prerequisites: 12 credits of graduate study in Education, or consent of instructor. Survey course in reading diagnosis and prescription for graduate students not majoring in Reading. The interpretation of reading diagnostic techniques with an overview of various prescriptions based on diagnosis.

EDEL 626 Problems in the Teaching of Reading in the Elementary School (3) Implications of current theory and the results of research for the teaching of reading in the elementary school. Attention is given to all areas of developmental reading instruction, with special emphasis on persistent problems.

EDEL 627 Clinical Assessment in Reading (3) Prerequisites: EDEL 430, EDEL 626, EDMS 446 and EDMS 622. Clinical diagnostic techniques and materials useful to the reading specialist in assessing serious reading difficulties.

EDEL 630 Clinical Remediation of Reading Disabilities (3) Prerequisites: EDEL 430, EDEL 626, EDMS 446 and 622. Remedial procedures and materials useful to the reading specialist in planning programs of individual and small group instruction.

EDEL 631 Advanced Laboratory Practices Diagnosis (3) Prerequisite: EDEL 630. Diagnostic work with children in clinic and school situations. Administration, scoring, interpretation, and prescription via diagnostic instruments is stressed. Case report writing and conferences are also stressed. EDEL 631 is taken with EDEL 632.

EDEL 632 Advanced Laboratory Practices (Instruction) (3) Prerequisite, EDEL 630. Remedial instruction with children in clinic and school situations. Develop competency in various remedial techniques, diagnostic teaching and evaluation. Development of the reading resource role is stressed. EDEL 632 is taken with EDEL 631.

EDEL 636 Communications and the School Curriculum (3) Curriculum development based on communication as the major vehicle for describing the learner's interactions with persons, knowledge, and materials in the classroom and school environment.

EDEL 640 Curriculum for Early Childhood Education (3) Basic examination of curriculum theory, research and practice in educational settings for children birth to eight. Primarily for entering master's students or post-master's students who have not had a basic graduate curriculum course in early childhood education.

EDEL 641 The Young Child in the Community (3) Analysis of the impact of major social and economic trends on young children through study and research of community agencies, commercial enterprises and social experiences.

EDEL 642 Teaching Strategies in Early Childhood Education (3) An examination of theory and research concerning teacher-learner interaction. Analysis of planning, organization of learning environments, evaluation of learning, general classroom management, and inter-personal relationships.

EDEL 643 Teacher-Parent Relationships (3) A study of the methods and materials, trends, and problems in establishing close home-school relationships.

EDEL 644 Intellectual and Creative Experiences in Early Childhood Education (3) A critical examination of theories of intellectual and creative development, language development, problem solving and critical thinking.

EDEL 650 Seminar in Early Childhood Education (3) A problem seminar in Early Childhood Education. Prerequisites: At least 12 hours of graduate work in Early Childhood Education.

EDEL 651 Staffing in Early Childhood Programs (3) Prerequisite: Admission to doctoral programs in early childhood education or educational administration; adminstrative experience or consent of instructor.

EDEL 652 Education and Group Care of the Infant and Young Child (3) Prerequisite: EDMS 446 or consent of the instructor. The historical, theoretical and empirical basis for the group care and education of young children with special emphasis on the child under the age of three.

EDEL 653 Curriculum Innovations in Early Childhood-Elementary Science Education (3) Prerequisite: Consent of instructor. A study of the most recently developed curricula in Early Childhood-Elementary Science Education including the psychological basis of each science curriculum; analysis of the components of each curriculum; and interaction with early childhood-elementary school children using selected activities from science curricula.

EDEL 701 Seminar in Research and Development of Science Education for Children (3) Prerequisites: EDEL 601 and EDEL 653; or consent of instructor. The development of science education for children; the study, description and interpretation of science education research reports; the identification and critical analysis of one specific topic in Early Childhood-Elementary Science Education; and the development of a research proposal for an investigation designed to furr the the student's knowledge of the selected topic in Early Childhood-Elementary Science Education.

EDEL 707 Elementary School Social Studies Research (3) Prerequisites: EDEL 607, EDMS 446, and 12 graduate hours in the Social Sciences. The indentification of a significant problem in Elementary School Social Studies, the design and execution of a research study to resolve the problem. Intended for advanced graduate students whose concentration is in Elementary School Social Studies.

EDEL 719 Research Seminar in Teaching and Learning of Elementary School Mathematics (3) Prerequisite: EDMS 645 and EDEL 613, or consent of instructor. Critical evaluation of past and current research, formulation of researchable questions, design and conduct of research in the teaching and learning of elementary school mathematics. Course may be repeated to a maximum of 6 credits.

EDEL 726 Research Design in Early Childhood Education (3) Prerequisites: EDMS 646 or equivalent. Provides opportunity for designing and conducting research with children from birth to eight years of age based on reviews, evaluations and discussions of significant and relevant early childhood research literature.

EDEL 729 Theory and Research Seminar in Reading (3) Prerequisite-Consent of instructor. Survey of the literature in reading and allied fields, an examination of current research directions and methodologies. Implications for classroom practice. Repeatable to a maximum of six credits.

EDEL 788 Special Topics in Elementary Education (1–3) Prerequisite, Consent of instructor. Special and intensive treatment of current topics and issues in Elementary Education. Repeatable to maximum of 6 credits.

EDEL 798 Special Problems in Education (1–6) Master's AGS, or doctoral candidates who desire to pursue special research problems under the direction of their advisers may register for credit under this number. Course card must have the title of the problem and the name of the faculty member under whom the work will be done.

EDEL 799 Master's Thesis Research (1–6) Registration required to the extent of six hours for master's thesis.

EDEL 888 Apprenticeship in Education (1–8) Apprenticeships in the major area of study are available to selected students whose application for an apprenticeship has been approved by the Education faculty. Each apprentice is assigned to work for at least a semester full-time or the equivalent with an appropriate staff member of a cooperating school,

school system, or educational institution or agency. The sponsor of the apprentice maintains a close working relationship with the apprentice and the other persons involved. Prerequisites, Teaching experience, a Master's degree in Education, and at least six semester hours in Education at the University of Maryland. Note: The total number of credits which a student may earn in EDEL 489, 888 and 889 is limited to a maximum of twenty (20) semester hours.

EDEL 889 Internship in Education (3–8) Internships in the major area of study are available to selected students who have teaching experience. The following groups of students are eligible: (a) Any student who has been advanced to candidacy for the doctor's degree; and (b) Any student who receives special approval by the Education faculty for an internship, provided that prior to taking an internship, such student shall have completed at least 60 semester hours of graduate work, including at least six semester hours in Education at the University of Maryland. Each intern is assigned to work on a full-time basis for at least a semester with an appropriate staff member in a cooperating school, school system, or educational institution or agency. The internship must be taken in a school situation different from the one where the student is regularly employed. The intern's sponsor maintains a close working relationship with the intern and the other persons involved.

Note: The total number of credits which a student may earn in EDEL 489, 888, and 889 is limited to a maximum of twenty (20) semester hours.

EDEL 899 Doctoral Dissertation Research (1–8) Registration required to the extent of 6–9 hours for an ED.D. project and 12–18 hours for a Ph.D. dissertation.

Economics Program

Professor and Chairman:
Professors: Almon, Bailey, Bergmann Brechling, Clague, Cumberland, Dillard, Gruchy, Harris, Kelejian, Marris, McGuire, Mueller, Oates, O'Connell, Olson, Schultze, Straszheim, Ulmer, Wonnacott
Associate Professors: Adams, Bennett, Betancourt, Johnson, Knight, Meyer, Weinstein.
Assistant Professors: Boner, Brown, Dunson, Lächler, Mans, Murrell, Panagariya, Pelcovits, Snower, Swartz, Vavrichek

Programs are offered leading to the Master of Arts and Doctor of Philosophy degrees. Areas of specialization include: economic theory, advanced economic theory, comparative economic systems and planning, econometrics, economic development, economic history, environmental and natural resource economics, history of economic thought, industrial organization, institutional economics, international economics, labor economics, monetary economics, public finance, regional and urban economics, and social policy.

Admission and Degree Information

Applicants should have taken (or should plan to take immediately) at least one advanced undergraduate course in each of microeconomics, macroeconomics, statistics, and calculus. In addition, the Aptitude Test section of the Graduate Record Examination is required, and the Advanced Economics Test is strongly recommended. Letters of recommendation from three persons competent to judge the probability of the applicant's success in graduate school should be sent directly to the Director of Graduate Studies in Economics. Part-time graduate study is difficult, since few courses are taught at night.

The Master of Arts degree in Economics may be taken under either (1) the thesis option (24 hours plus a thesis) or (2) the non-thesis option (30 hours, including Economics 621–622, plus a written examination in Economic Theory and a research paper). The requirements for the non-thesis option for the M.A. are met automatically in the course of the Ph.D. program in Economics.

The main requirements of the Ph.D. program are (1) a written examination in economic theory, normally taken at the beginning of the second year of full-time graduate study; (2) written examinations in two approved optional fields; (3) a comprehensive oral examination covering economic theory and the two optional fields; (4) two courses (ECON 621–622) in Quantitative Methods in Economics; (5) two courses (ECON 606, 607) in the History of Economic Thought; or one in Thought and one in Economic History (ECON 611 or 613); (6) foreign language competency or one of several options; (7) a research paper available to the faculty at the time of the oral comprehensive examination; (8) a dissertation and its successful oral defense.

Facilities and Special Resources

The graduate program in Economics is a comprehensive one. The department possesses special strength in the Economics of the Public Sector and Public Choice. The department has general strengths in social policy, poverty, natural resources and the environment, in international economics and economic development, and other applied areas. Special research projects under the supervision of faculty members are carried on in the Economics of Environmental Management, Inter-industry Forecasting, and other fields.

Financial Assistance

Research assistantships are available in special projects. Numerous teaching assistantships are also available. The department can usually help graduate students find half-time employment in Federal agencies engaged in economic research. There are a limited number of fellowships available, including several for members of groups presently underrepresented among economists.

Additional Information

A complete description of the requirements of the degrees in economics and the admission process is available on request from: Director of Graduate Studies in Economics, Department of Economics, University of Maryland.

Courses

ECON 401 National Income Analysis (3) Prerequisite: ECON 201, 203. Required for economics majors. Analysis of the determination of national income, employment, and price levels. Discussion of consumption, investment, inflation, and government fiscal and monetary policy.

ECON 402 Business Cycles (3) First semester. Prerequisite: ECON 430. A study of the causes of depressions and unemployment, cyclical and secular instability, theories of business cycles, and the problem of controlling economic instability.

ECON 403 Intermediate Price Theory (3) Prerequisite: ECON 201, 203. Required for economics majors. An analysis of the theories of consumer behavior and of the firm, and of general price and distribution theory, with applications to current economic issues.

ECON 407 Contemporary Economic Thought (3) Prerequisites: ECON 201, 203, and senior standing. Graduate students should take ECON 705. A survey of the development of economic thought since 1900 with special reference to Thorstein Veblin end other pre-1939 institutionalists and to post-1945 neo-institutionalists such as J.K. Galbraith and Gunnar Myrdal.

ECON 415 Introduction to Economic Development of Underdeveloped Areas (3) Prerequisite: ECON 201 and 203; or 205. An analysis of the economic and socie! characteristics of underdeveloped areas. Recent theories of economic development, obstacles to development, policies and planning for development.

ECON 418 Economic Development of Selected Areas (3) A—Latin America B—Asia C—Africa Prerequisite: ECON 415. Institutional characteristics of a specific area are discussed and alternate strategies and policies for development are analyzed.

ECON 421 Economic Statistics (3) Prerequisite: MATH 110 or equivalent. Not open to students who have taken BSAD 230 or BSAD 231. An introduction to the use of statistics in economics. Topics include: probability, random variables and their distributions, sampling theory, estimation, hypothesis testing, analysis of variance, regression analysis, correlation.

ECON 422 Quantitative Methods in Economics (3) Prerequisites: ECON 201, 203, and 421 (or BSAD 230); or permission of instructor. Emphasizes the interaction between the economic problems posed by economists and the assumptions employed in statistical theory. Deals with the formulation, estimation and testing of economic models. Topics include single variable and multiple variable regression techniques, theory of identification, autocorrelation and simultaneous equations. Independent work relating the material in the course to an economic problem chosen by the student is required.

ECON 425 Mathematical Economics (3) Prerequisites: ECON 401 and 403 and one year of college mathematics. A course designed to enable economics majors to understand the simpler aspects of mathematical economics. Those parts of the calculus and algebra required for economic analysis will be presented.

ECON 430 Money and Banking (3) Prerequisite: ECON 201, 203. Relation of money and credit to economic activity and prices; impact of public policy in financial markets and for goods and services; policies, structure, and functions of the federal reserve system; organization, operation, and functions of the commercial banking system, as related particularly to questions of economic stability and public policy

ECON 431 Theory of Money, Prices and Economic Activity (3) Prerequisite: ECON 430. A theoretical treatment of the influence of money and financial markets on economic activity and prices, and of the effects of monetary policy on the markets for goods and services; the role of money in the classical and Keynesian macro-systems; topics of theoretical interest in monetary policy formation and implementation.

ECON 440 International Economics (3) Prerequisite: ECON 201, 203. A descriptive and theoretical analysis of international trade, balance of payments accounts, the mechanism of international economic adjustment, comparative costs, economics of customs unions.

ECON 441 International Economic Policies (3) Prerequisites: ECON 401, 403, and 440. Contemporary balance of payments problems; the international liquidity controversy investment, trade and economic development; evaluation of arguments for protection.

ECON 450 Introduction to Public Finance (3) Prerequisite: ECON 201, 203; or ECON 205. The role of federal, state, and local governments in meeting public wants. Analysis of tax theory end policy, expenditure theory, government budgeting, benefit-cost analysis, and income redistribution.

ECON 451 Public Choice and Public Policy (3) Prerequisite: ECON 201, 203, or 205. Analysis of collective decision making, economic models of government, program budgeting, and policy implementation; emphasis on models of public choice and institutions which affect decision making.

ECON 454 State and Local Public Finance (3) Prerequisite: ECON 201 and 203; or 205. Principles and problems of governmental finance with special reference to state and local jurisdictions. Topics to be covered include taxation, expenditures and intergovernmental fiscal relations.

ECON 460 Industrial Organization (3) Prerequisite: ECON 201 and 203; or 205. Changing structure of the American economy; price policies in different industrial classifications of monopoly and competition in relation to problems of public policy

ECON 471 Current Problems in Labor Economics (3) Prerequisite: ECON 470. For students who wish to pursue, in depth, selected topics in the labor field. Issues and topics selected for detailed examination may include: manpower training end development, unemployment compensation end social security, race

and sex discrimination in employment, wage theory, productivity analysis, the problems of collective bargaining in public employment, wage-price controls and incomes policy.

ECON 482 Economics of the Soviet Union (3) Prerequisite: ECON 201 and 203; or 205. An analysis of the organization, operating principles and performance of the soviet economy with attention to the historical and ideological background, planning, resources, industry, agriculture, domestic and foreign trade, finance, labor, and the structure and growth of national income.

ECON 484 The Economy of China (3) Prerequisite: ECON 201 and 203; or 205. Policies and performances of the Chinese economy since 1949. Will begin with a survey of modern China's economic history. Emphasizes the strategies and institutional innovations that the Chinese have adopted to overcome the problems of economic development. Some economic controversies raised during the 'cultural revolution' will be covered in review of the problems and prospects of the present Chinese economy.

ECON 486 The Economics of National Planning (3) Prerequisite: ECON 201 and 203; or 205. An analysis of the principles and practice of economic planning with special reference to the planning problems of West European countries and the United States.

ECON 490 Survey of Urban Economic Problems and Policies (3) Prerequisites: ECON 201 and 203; or 205. An introduction to the study of urban economics through the examination of current policy issues. Topics may include suburbanization of jobs and residences, housing and urban renewal, urban transportation, development of new towns, ghetto economic development, problems in services such as education and police.

ECON 491 Economics and Control of Urban Growth (3) Prerequisite: ECON 490. An analysis of metropolitan development processes, the consequences of alternative growth patterns, and the evaluation of policies to control growth.

ECON 492 Economics of Location and Regional Growth (3) Prerequisite: ECON 403, or consent of instructor. Study of the theories, problems, and policies of regional economic development and the location of economic activity for both rural and metropolitan regions. Methods of regional analysis.

ECON 601 Macro-Economic Analysis (3) First semester of a two-semester sequence, 601 and 602. Topics normally include general equilibrium theory in classical, Keynesian, and post-Keynesian treatments; the demand for money; theories of consumption behavior and of inflation.

ECON 602 Economic Growth and Instability (3) Second semester. A continuation of ECON 601. Major topics include growth and technological change, investment, business cycles, and large empirial macroeconomic models. Also included are material on wages and employment and on international and domestic stability.

ECON 603 Micro-Economic Analysis I (3) Prerequisite: A calculus course or concurrent registration in ECON 621. The first semester of a two-semester sequence which analyzes the usefulness and shortcomings of prices in solving the basic economic problem of allocating scarce resources among alternative uses. The central problem of welfare economics and general equilibrium as a framework for a detailed analysis of consumption and production theories including linear programming with decisions under uncertainty.

ECON 604 Micro-Economic Analysis II (3) Prerequisite: ECON 603. A continuation of ECON 603. Theory of capital, interest and wages. Qualifications of the basic welfare theorem caused by noncompetitive market structures, external economies and diseconomies and secondary constraints. Application of price theory to public expenditure decisions, investment in human capital, international trade, and other areas of economics.

ECON 605 Welfare Economics (3) First semester. Prerequisite: ECON 603. The topics covered include pareto optimality, social welfare funtions, indivisibilities, consumer surplus, output and price policy in public enterprise, and welfare aspects of the theory of public expenditures.

ECON 606 History of Economic Thought (3) First semester. Prerequisite: ECON 403 or consent of the instructor. A study of the development of economic thought and theories including the Greeks, Romans, Canonists, Mercantilists, Physiocrats, Adam Smith, Malthus, Ricardo. Relation of ideas to economic policy.

ECON 607 Economic Theory in the Nineteenth Century (3) Second semester. Prerequisite: ECON 606 or consent of the instructor. A study of nineteenth-century and twentieth-century schools of economic thought, particularly the Classicists, Neo-Classists, Austrians, German historical school, American economic thought, the Socialists, and Keynes.

ECON 611 Seminar in American Economic Development (3)

ECON 613 Origins and Development of Capitalism (3) Second semester. Studies the transition from feudalism to modern capitalistic economies in Western Europe. Whenever possible, this economic history is analyzed with the aid of tools of modern economics, and in the light of comparisons and contrasts with the less developed areas of the present day.

ECON 615 Economic Development of Underdeveloped Areas (3) First semester. Prerequisite: ECON 401 and 403. An analysis of the forces contributing to and retarding economic progress in underdeveloped areas. Macro and micro-economic aspects of development planning and strategy are emphasized.

ECON 616 Seminar in Economic Development (3) Second semester. Prerequisite: ECON 615 or consent of instructor. A continuation of ECON 615. Special emphasis is on the application of economic theory in the institutional setting of a country or area of particular interest to the student.

ECON 617 Money and Finance in Economic Development (3) First semester. Economic theory, strategy and tactics for mobilizing real and financial resources to finance and accelerate economic development. Monetary, fiscal, and tax reform policy and practice by the government sector to design and implement national development plans.

ECON 621 Quantitative Economics I (3) First semester. An introduction to the theory and practice of statistical inference. Elements of computer programming and a review of mathematics germane to this and other graduate economics courses are included.

ECON 622 Quantitative Economics II (3) Second semester. Prerequisite: ECON 621. Techniques of estimating relationships among economic variables. Multiple regression, the analysis of variance and covariance, and techniques for dealing in time series. Further topics in mathematics.

ECON 661 Advanced Industrial Organization (3) First semester. Prerequisite: ECON 401 and 403 or consent of instructor. Analysis of market structure and its relation to market performance.

ECON 662 Industrial Organization and Public Policy (3) Second semester. Prerequisite: ECON 661 or consent of instructor. Analysis of the problems of public policy in regard to the structure, conduct, and performance of industry. Examination of anti-trust policy from the point of view of economic theory.

ECON 671 Seminar in Labor Economics (3) First semester. Formal models of labor demand, supply, utilization and price formation. Factors affecting labor supply; the determination of factor shares in an open economy; bargaining models, labor resources, trade union theories as they affect resource allocation.

ECON 672 Selected Topics in Labor Economics (3) Second semester. The wage-price issue; public policy with respect to unions, labor-management relations, and the labor market; institutional aspects of the American labor movement; manpower development and training.

ECON 682 Seminar in Economic Development of the Soviet Union (3) Second semester. Prerequisite: ECON 482 or consent of instructor. Measurement and evaluation of soviet economic growth including interpretation and use of Soviet statistics, measurement of national income, fiscal policies, investment and technological change, planning and economic administration, manpower and wage policies, foreign trade and aid. Selected topics in bloc development and reform.

ECON 686 Economic Growth in Mature Economies (3) A comparative analysis of measures for achieving economic stability and progress in mature economies such as the major West European countries and the United States, including fiscal and monetary policies, tax incentives, manpower programs, redistributional efforts, planning procedures and nationalization.

ECON 698 Selected Topics in Economics (3)

ECON 703 Advanced Economic Theory I (3) Prerequisite: Background in calculus and matrix algebra such as provided by ECON 621 and 622. Optimization techniques such as Lagrangian multipliers and linear programming. Mathematical treatment of general equilibrium, including interindustry analysis, the theory of production, consumption, and welfare.

ECON 704 Advanced Economic Theory II (3) Prerequisite: ECON 703. Multi-sectoral growth models and questions of optimal growth. Last half of course consists of presentations of seminar papers.

ECON 705 Seminar in Institutional Economic Theory (3) Second semester. A study of the recent developments in the field of institutional economic theory in the United States and abroad.

ECON 706 Seminar in Institutional Economic Theory (3)

ECON 721 Econometrics I (3) First semester. Special topics in mathematical statistics necessary for understanding econometric theory, with particular emphasis on multivariate analysis. The estimation of simultaneous equation systems, problems involving errors in variables, distributed lags, and spectral analysis.

ECON 722 Seminar in Quantitative Economics (3) Second semester. Prerequisite: ECON 622 or consent of instructor. Analysis of data sources for economic research; critical evaluation of previous and current quantitative economic studies; and class discussion and criticism of student research projects.

ECON 731 Monetary Theory and Policy (3) First semester. An adequate knowledge of micro and macro-economics is assumed. Theory of money, financial assets, and economic activity; review of classical, neo-classical and Keynesian contribution; emphasis on post-Keynesian contributions, including those of Tobin, Patinkin, Gurley-Shaw, Friedman, and others.

ECON 732 Seminar in Monetary Theory and Policy (3) Second semester. Prerequisite: ECON 731 or consent of instructor. Theory of the mechanisms through which central banking affects economic activity and prices; formation and implementation of of monetary policy; theoretical topics in monetary policy.

ECON 741 Advanced International Economics I (3) Prerequisite: ECON 601. The international mechanism of adjustment: price, exchange rate, and income changes. The flexible exchange rate system, international monetary reform and international investment and capital flows.

ECON 742 Advanced International Economics II (3) Prerequisite: ECON 603 and ECON 741. The pure theory of international trade. Comparative costs, the Heckscher-Ohlin Theorem, and the effect of trade on factor prices. Tariff analysis, commercial policy and customs unions. The gains from trade and ranking of policy interventions.

ECON 751 Advanced Theory of Public Finance (3) Review of utility analysis to include the theory of individual consumer resource allocation and exchange and welfare implications. Effects of alternative tax and subsidy techniques upon allocation, exchange, and welfare outcomes. Theories of public goods, their production, exchange and consumption. Principles of benefit-cost analysis for government decisions.

ECON 752 Seminar in Public Finance (3) Second semester. Theory of taxation and tax policy, with particular emphasis on income taxation; empirical studies; the burden of the public debt. Research paper by each student to be presented to seminar.

ECON 775 Poverty and the Labor Market (3) Prerequisite: ECON 603 and 622, or consent of instructor. Theories of income distribution and factor shares; human capital theory, empirical applications, and criticisms; theories and measurement of discrimination; the operation of labor markets, trade unions, and minimum wage laws; economic fluctuations and income distribution.

ECON 776 Policies Affecting Income Distribution (3) Prerequisite: ECON 603 and 622, or consent of instructor. Ethics of distribution; measures of income, income distribution, and poverty; incidence of taxation and public expenditures; the design of distributional policies, in-kind versus cash assisstance; particular policy areas, education finance, housing assisstance, medical care, child care, cash transfer programs.

ECON 781 Advanced Environmental Economics (3) Prerequisites: ECON 603 and 621, or consent of instructor. Theory of externalities, microeconomic models of pollution damage functions, benefits and costs of alternative pollution control measures, macroeconomic models of material and energy balance, limits to economic growth and long-run problems of intergenerational and interregional efficiency and equity.

ECON 785 Advanced Economics of Natural Resources (3) Prerequisites: ECON 603 and 621, or consent of instructor. The rate of use of renewable and non-renewable resources from the normative and positive points of view; evaluation of alternative uses of natural environments; irreversibilities, discounting and intergenerational transfers. Discussion of natural resource problems and policies.

ECON 790 Advanced Urban Economics (3) Market processes and public policies as related to urban problems and metropolitan change. Employment, housing, discrimination, transportation and the local public sector.

ECON 792 Regional and Urban Economics (3) Theoretical and empirical analysis of the location and spatial distribution of economic activity. Analysis of regional growth and development. The study of analytical methods and forecasting models.

ECON 799 Master's Thesis Research (1–6)

ECON 899 Doctoral Dissertation Research (1–8)

Electrical Engineering Program

Professor and Chairman: Harger
Professors: Chu[1], Davisson, DeClaris, Hochuli, Lee, Ligomenides, Lin Newcomb, Ott[2], Reiser[2], Taylor, White (part–time)
Associate Professors: Baras, Basham, Blankenship, Davis, Destler, Emad, Ephremides, Levine, Pugsley, Rhee, Silio, Simons, Striffler, Tretter, Wang, Zajac, Zaki
Assistant Professors: Krishnaprasad

[1]joint appointment with Computer Science
[2]joint appointment with Physics

The Electrical Engineering Department offers graduate programs leading to the M.S. and Ph.D. degrees. A diverse offering of courses, as well as seminars, colloquium series, and thesis guidance, encompasses a broad spectrum of topics. Specialization is possible in bioelectrical engineering (neurophysiological systems, networks, and signals), circuits (network analysis and synthesis, microwave and integrated circuits, computer-aided design), communications (random processes; detection, estimation and coding, information theories; digital signal processing, optical communications, communication networks, remote sensing systems), computers (computer architecture and design, operating and software systems), control (computer-aided design, nonlinear, sampled data, and distributed parameter systems, system optimization, optimal and stochastic control), and electrophysics (electromagnetic theory, charged-particle dynamics, quantum electronics, microwave, antenna, and optical engineering), lasers, nonlinear optics, and spectroscopy. Joint programs are maintained with the mathematics, physics, and computer science departments and the material science and transportation programs. Opportunities for programs of study in conjunction with many national laboratories and technical facilities also exist. The department has active theoretical research projects in optical communication, communication networks, coding theory, traffic control, remote sensing, solar energy conversion devices, and many other areas.

Admission and Degree Information

Present minimum requirement for admission to the Graduate School as an Electrical Engineering student is graduation from an ECPD accredited undergraduate program in Electrical Engineering with an average no lower than B, or similar undergraduate preparation in mathematics, computer science, physics, or other areas of engineering or science.

Requirements for the master's thesis and nonthesis options are those of the Graduate School. All requirements must be completed within 5 years.

Requirements for the Ph.D. degree include a minimum of 42 semester hours of graduate approved courses; the Ph.D. qualifying examination; and completion of all dissertation and oral examination requirements.

Facilities and Special Resources

There are modern research and project laboratories within the department which support a wide variety of research programs. These laboratories include a laser and electromagnetics laboratory; a microprocessor development laboratory; a gas laser laboratory (He, Ne, and CO2 laser stability and lifetime and applications); a solid state laser laboratory (nonlinear optics); an integrated circuits laboratory (a full-line facility capable of producing monolithic, thin-film, and MOS structures); a microwave circuits laboratory; and an electron-ring accelerator laboratory (ion beam acceleration studies). The department has a computational facility with conversational and remote-batch terminals linked to the University's UNIVAC 1108 digital computers, as well as PDP-9 and PDP–11 digital computers, and AD–5 analog computer, microcomputers and minicomputers, and associated peripherals. A complete engineering library is housed nearby in conjunction with the mathematics and physical science collections.

Financial Assistance

Financial aid is available to graduate students in the form of Graduate Research Assistantships, Graduate Teaching Assistantships and Fellowships. Applications for Graduate Research and Teaching Assistantships should be completed and sent to the Electrical Engineering Office of Graduate Studies.

Graduate Research Assistantships are awarded subject to availability of funds and are renewed subject to satisfactory research progress. Summer appointments are often available.

Graduate Teaching Assistantships are usually awarded in April. Preference is given to United States citizens. Duties may include laboratory teaching assignments, assistance in the computation facility, or assistance in courses. Teaching Assistants must register for at least nine credit hours per semester.

Local industries and government agencies have work-study programs in which about half of the Electrical Engineering graduate student body participates. Application should be made directly to the agencies.

Additional Information

Special brochures or publications offered by the Department may be obtained by writing to this address:

Electrical Engineering Office of
Graduate Studies
University of Maryland

Courses

ENEE 400 Computer Aided Circuit Analysis (3) Prerequisite: ENEE 314. Computer aided analysis of electronic devices and components. Network topology, computer formulation of Kirchhoff laws, Nodal analysis of linear and non-linear networks, computer formulation of the state equations, time domain and frequency domain solution, sensitivity calculations.

ENEE 402 Advanced Pulse Techniques (3) (See ENEE 403 for optional related laboratory course). Prerequisite, ENEE 314 or 410 or equivalent. Bistable, monostable, and astable circuits, sweep circuits, synchronization, counting, gates, comparators. Magnetic core circuits, semi-conductor and vacuum-tube circuits.

ENEE 407 Microwave-Circuits Laboratory (2) Prerequisite, Senior standing in electrical engineering or consent of instructor. One lecture and three lab hours per week. Experiments concerned with circuits constructed from microwave components providing practical experience in the design, construction and testing of such circuits. Projects include microwave filters and S-parameter design with applications of current technology.

ENEE 410 Electronic Circuits (3) Prerequisite: ENEE 300 or equivalent knowledge of circuit theory or consent of the instructor. This course is intended for students in the physical sciences, and for engineering students requiring additional study of electron circuits. Credit not normally given for this course in an electrical engineering major program. (ENEE 413 may optionally be taken as an associated laboratory). P-N junctions, transistors, vacuum tubes, biasing and operating point stability, switches, large-signal analysis, models, small-signal analysis, frequency response, feedback and multistage amplifiers, pulse and digital circuits.

ENEE 412 Telemetry Systems (3) Prerequisite: ENEE 314. Selected digital circuits; frequency division multiplexing, FM/AM systems, SSB/FM systems; time division multiplexed systems; pulse amplitude modulation; pulse duration modulation: pulse code modulation: analog to digital converters: multiplexers and DC-commutators.

ENEE 413 Electronics Laboratory (2) Corequisite: ENEE 314. One lecture and three lab hours per week. Provides experience in the specification, design, and testing of basic electronic circuits and practical interconnections. Emphasis on design with discrete solid state and integrated circuit components for both analog and pulse circuits.

ENEE 414 Network Analysis (3) Prerequisite: ENEE 304. Network properties: linearity, reciprocity, etc.; 2-port descriptions and generalization: Y, S, hybird matrices; description properties: symmetry, para-unity, etc.; basic topological analysis; state-space techniques; computer-aided analysis; sensitivity analysis; approximation theory.

ENEE 416 Network Synthesis (3) Prerequisite:—ENEE 304. Active and passive components, passivity, bounded and positive real, rc properties and synthesis, Brune and Darlington synthesis, transfer-voltage and Y21 synthesis, active feedback configurations, image parameter design, computer-aided optimization synthesis via the embedding concept.

ENEE 418 Projects in Electrical Engineering (1–3) Hours to be arranged. Prerequisites: Senior standing and permission of the instructor. May be taken for repeated credit up to a total of 4 credits, with the permission of the student's advisor and the instructor. Theoretical and experimental projects.

ENEE 419 Apprenticeship in Electrical Engineering (2–3) Hours to be arranged Prerequisite: Completion of sophomore courses and permission of an apprenticeship director. May be taken for repeated credit up to a total of nine credits. A unique opportunity for experience in experimental research and engineering design. A few highly qualified students will be selected as apprentices in one of the research facilities of the electrical engineering department and will participate in the current research under the supervision of the laboratory director. In the past, apprenticeships have been available in the following laboratories: biomedical, electron ring accelerator, gas laser, integrated circuits, simulation and computer, and solid state laser.

ENEE 420 Communication Systems (3) Prerequisite: ENEE 324. Fourier series, Fourier transforms and linear system analysis; random signals, autocorrelation functions and power spectral densities; analog communication systems: amplitude modulation, single-sideband modulation, frequency and phase modulation, sampling theorem and pulse-amplitude modulation; digital communication systems pulse-code modulation, phase-shift keying, differential phase shift key-

ing, frequency shift keying; performance of analog and digital communication systems in the presence of noise.

ENEE 421 Information Theory and Coding (3) Prerequisite: ENEE 324. Definition of information and entropy memoryless and Markov sources; source coding; Kraft and MacMillan inequalities; Shannon's First Theorem; Hoffman Codes; channels, mutual information, and capacity; Shannon's noisy channel coding theorem; error correcting codes.

ENEE 425 Digital Signal Processing (3) Prerequisite: ENEE 322. Sampling as a modulation process; aliasing; the sampling theorem; the Z-transform and discrete-time system analysis; direct and computer-aided design of recursive and nonrecursive digital filters; the discrete Fourier transform (DFT) and fast Fourier transform (FFT); digital filtering using the FFT; analog-to-digital and digital-to analog conversion; effects of quantization and finite-word-length arithmetic.

ENEE 432 Electronics for Life Scientists (4) Three hours of lecture and two hours of laboratory per week. Prerequisites: College algebra and a physics course, including basic electricity and magnetism. Not accepted for credit in an Electrical Engineering major program. The concept of an instrumentation system with emphasis upon requirements for transducers, amplifiers, and recording devices, design criteria and circuitry of power supplies amplifiers, and pulse equipment, specific instruments used for biological research, problems of shielding against hum and noise pickup and other interference problems characteristic of biological systems.

ENEE 433 Electronic Instrumentation for Physical Science (3) Two hours of lecture and two hours of laboratory per week. Prerequisites: ENEE 300 or 306, PHYS 271 or equivalent, or consent of instructor. The concept of instrumentation systems from sensor to readout; discussions of transducers, system dynamics, precision and accuracy; measurement of electrical parameters; direct, differential, and potentiometric measurements; bridge measurements, time and frequency measurements, waveform generation and display.

ENEE 434 Introduction to Neural Networks and Signals (3) Prerequisite: ENEE 204 or 300. Introduction in the generation and processing of bioelectric signals including structure and function of the neuron, membrane theory, generation and propagation of nerve impulses, synaptic mechanisms, transduction and neural coding of sensory events, central nervous system processing of sensory information and correlated electrical signals, control of effector organs, muscle contraction and mechanics, and models of neurons and neural networks.

ENEE 435 Electrodes and Electrical Processes in Biology and Medicine (3) Prerequisite: ENEE 204 or 300. Techniques for recording biological signals such as brain, muscle and cardial electrical potentials; membrane theory; half-cell potentials, liquid junction potentials, polarization of electrodes; biological and medical instrumentation; and applications in the design of cardial pacemakers, or a similar case study.

ENEE 438 Topics in Biomedical Engineering (1–3) Prerequisite: Permission of the instructor. May be taken for repeated credit. The content may vary from semester to semester. Selected topics of current interest from such areas as bioelectric systems, modeling instrumentation, automated diagnostic, health-care delivery, etc. Repeatable to a maximum of 9 hours.

ENEE 442 Software Engineering (3) Prerequisites: ENES 240; ENEE 250 or equivalent. Architectural aspects of software engineering. Machine language and machine structure; assembly language and assemblers; macro-language and macro-processors; loaders and linkers; programming languages and language structure; compilers and interpreters; operating systems.

ENEE 444 Logic Design of Digital Systems (3) Prerequisite: ENEE 250. Review of switching algebra; gates and logic modules; map simplification techniques; multiple-output systems; memory elements and sequential systems; large switching systems; iterative networks; sample designs, computer oriented simplification algorithms; state assignment; partition techniques; sequential system decompositions.

ENEE 445 Computer Laboratory (2) Prerequisite: ENEE 444. One lecture and three lab hours per week. Hardware-oriented experiments providing practical experience in the design, construction, and checkout of components and interfaces for digital computers and data transmission systems. Projects include classical design techniques and applications of current technology.

ENEE 446 Digital Computer Design (3) Prerequisite: ENEE 250. Essential elements of the hardware design of digital computers. Arithmetic and logic units, adders, multipliers, dividers, logic and shifting operations, floating point arithmetic. Memory organization, design of a basic computer: instruction set, bus structure, fetch-execute microoperations, hard-wired control unit, microprogrammed control unit, index registers, indirect addressing, interrupt operation, direct memory access. Organization of commercially available computers. No student will be allowed credit for both CMSC 410 and ENEE 446.

ENEE 450 Discrete Structures (3) Prerequisite: ENES 240 or equivalent. Review of set algebra including relations, partial ordering and mappings. Algebraic structures including semigroups and groups. Graph theory including trees and weighted graphs. Boolean algebra and prospositional logic. Applications of these structures to various areas of Computer Engineering.

ENEE 460 Control Systems (3) Prerequisite: ENEE 322. Mathematical models for control system components. Transform and time domain methods for linear control systems. Introductory stability theory. Root locus, Bode diagrams and Nyquist plots. Design specifications in the time and frequency domains. Compensation design in the time and frequency domain. Introduction to sampled data systems. Introduction to computer aided design of control systems.

ENEE 461 Control Systems Laboratory (2) Prerequisite: ENEE 460. One lecture and three lab hours per week. Projects to enhance the student's understanding of feedback control systems and to familiarize him with the characteristics and limitations of real control devices. Students will design, build, and test servomechanisms, and will conduct analog and hybrid computer simulations of control systems.

ENEE 462 Systems, Control and Computation (3) Prerequisites: ENEE 300 or 304, and MATH 246 or consent of instructor. Matrix algebra, state space analysis of discrete systems, state space analysis of continuous systems, computer algorithms for circuit analysis, optimization and system simulation.

ENEE 472 Transducers and Electrical Machinery (3) Prerequisite: ENEE 304. Electromechanical transducers, theory of electromechanical systems, power and wideband transformers, rotating electrical machinery from the theoretical and performance points of view.

ENEE 473 Transducers and Electrical Machinery Laboratory (1) Corequisite: ENEE 472. Experiments on transformers, synchronous machines, induction motors, synchros, loudspeakers, other transducers.

ENEE 480 Fundamentals of Solid State Electronics (3) Prerequisite: ENEE 381. Review of Maxwell's Equation, electromagnetic properties of dielectrics; introduction to quantum mechanics and quantum statistics; classical and quantum theory of metals; theory of semiconductors and semiconductor devices; principle of magnetic devices and selected topics.

ENEE 481 Antennas (3) Prerequisite: ENEE 381. Introduction to the concepts of radiation, generalized far field formulas; antenna theorems and fundamentals; antenna arrays, linear and planar arrays; aperture antennas; terminal impedance; propagation.

ENEE 483 Electromagnetic Measurements Laboratory (2) Prerequisites: ENEE 305 and ENEE 380. One lecture and three lab hours per week. Experiments designed to provide familiarity with a large class of micro-wave and optical components, techniques for interconnecting them into useful systems, and techniques of high frequency and optical measurements.

ENEE 487 Particle Accelerators, Physical and Engineering Principles (3) Prerequisites: ENEE 380 and PHYS 420, or consent of the instructor. Sources of charged particles; methods of acceleration and focusing of ion beams in electromagnetic fields; basic theory, design, and engineering principles of particle accelerators.

ENEE 488 Topics in Electrical Engineering (3) Prerequisite: Permission of the instructor. May be taken for repeated credit up to a total of six credits, with the permission of the student's advisor and the instructor.

ENEE 496 Lasers and Electro-Optic Devices (3) Pre-or corequisite: ENEE 381. Optical resonators, Fabry-Perot Etalon. Theory of laser oscillation, rate equations. Gaseous, solid state, semiconductor and dye laser systems. Electro-optic effects and parametric oscillators. Holography.

ENEE 601 Active Network Analysis (3) Prerequisite: ENEE 406 or equivalent. The complex frequency plane, conventional feedback and sensitivity, theorems for feedback circuits, stability and physical realiability of electrical networks, Nyquist's and Routh's criteria for stability, activity and passivity criteria.

ENEE 604 Advanced Electronic Circuit Design (3) Prerequisite: ENEE 312 or consent of the instructor. Comparison of bipolar and field effect transistors, detailed frequency response of single and multistage amplifiers, design of feedback applifiers, D-C coupling techniques, design of multistage tuned amplifiers.

ENEE 605 Graph Theory and Network Analysis (3) Prerequisite: ENEE 600. Linear graph theory as applied to electrical networks, cut sets and tie sets, incidence matrices, trees, branches, and mazes, development of network equations by matrix and index notation, network characteristic equations for natural circuit behavior, signal-flow-graph theory and Mason-S rule, stability of active two-part networks.

ENEE 608 Graduate Seminar (1–3) Prerequisite: Consent of instructor. Every semester regular seminars are held in electrical science and in the six areas of specialization offered by the electrical engineering department. They may be taken, by arrangement with the student's advisor, for repeated credit.

ENEE 609 Projects in Electrical Engineering (1–3) Prerequisite: Consent of the instructor. Individual projects on advanced systems in electrical engineering. May be repeated for credit up to a maximum of three credits.

ENEE 610 Electrical Network Theory (3) Undergraduate circuit theory or consent of the instructor. Matrix algebra, network elements, ports, passivity and activity, geometrical and analytical descriptions of networks, state variable characterizations, scattering matrices, signal flow graphs, sensitivity.

ENEE 620 Random Processes in Communication and Control (3) Prerequisite: ENEE 324 or equivalent. Introduction to random processes: characterization, classification, representation; Gaussian and other examples. Linear operations on random processes, stationary processes: covariance function and spectral density. Linear least square waveform estimating Wiener-Kolmogroff filtering, Kalman-Bucy recursive filtering: function space characterization, non-linear operations on random processes.

ENEE 621 Estimation and Detection Theory (3) Prerequisite: ENEE 620 or equivalent or consent of instructor. Estimation of unknown parameters, Cramer-Rao lower bound; optimum (map) demodulation; filtering, amplitude and angle modulation, comparison with conventional systems; statistical decision theory Bayes, Minimax, Neyman/Pearson, Criteria-68 simple and composite hypotheses; application to coherent and incoherent signal detection; M-ary hypotheses; application to uncoded and coded digital communication systems. (Listed also as MAPL 644.)

ENEE 630 Advanced Topics—Radar Signals and Systems (3) Corequisite: ENEE 620. Review of linear systems and signals: Fourier transform representation time bandwidth product, resolution, complex representation; maximum signal-to-noise ratio criterion receiver and signal design, radar range equation; statistical detection theory: probability of error performance; statistical estimation theory: unknown parameters, range-Doppler radar, ambiguity problem, asymptotic maximum likelihood estimation and Cramer-Rao lower bound; resolution of multiple objects.

ENEE 633 Modeling of Nerves and Muscles with Applications to Prosthetic Devices (3) Prerequisite: Undergraduate degree in Engineering or Physics, or permission of the instructor. Principles and circuit models for resting and active membrane potentials of nerves and muscles; synaptic mechanisms including probabilistic models of neuromuscular transmission; electrode potentials and reactions; propagation of biopotentials in a volume conductor; properties, mechanical models, and circuit analogs for muscles and proprioceptors; spinal reflexes in the control of posture; applications of the above in the design of prosthetic and orthotic devices.

ENEE 634 Models of Transduction and Signal Processing in Sensory Systems (3) Prerequisite: ENEE 633 or ENEE 435 or permission of the instructor. General organization of sensory systems; receptor

mechanisms; receptor and neural models; statistics of neural spike trains; peripheral signal processing in sensory systems, with emphasis on vision and audition; introduction to signal processing in the central nervous system; applications to development of sensory protheses.

ENEE 642 Software System Implementation (3) Prerequisite: ENEE 442 or equivalent. Implementation aspects of software engineering. Programming languages; architectural designs; program design; structured programming; peripheral storage devices; I/O programming; debugging and evaluation.

ENEE 646 Digital Computer Design (3) Prerequisite: ENEE 446. Introduction to design techniques for digital computers; digital arithmetic; logic circuits; digital memories; design of computer elements; arithmetic unit; and control unit. A simple digital computer will be designed.

ENEE 648 Advanced Topics in Electrical Engineering (3) Every semester courses intended for high degree of specialization are offered by visiting or regular electrical engineering faculty members in two or more of the areas listed in 488. The student should check with the electrical engineering office of graduate studies for a list and the description of the topics offered currently.

ENEE 654 Combinatorial Switching Theory (3) Prerequisites: ENEE 450 and ENEE 444. Application of algebraic techniques to combinatorial switching networks; multi-valued systems; symmetries and their use; optimization algorithms; heuristic techniques; majority and threshold logic; function decomposition; cellular cascades.

ENEE 655 Structure Theory of Machines (3) Prerequisites: ENEE 450 and ENEE 444. Machine realizations; partitions and the substitution property; pair algebras and applications; variable dependence; decomposition; loop-free structures; set system decompositions; semigroup realizations.

ENEE 657 Simulation of Dynamic Systems (3) Prerequisite: ENEE 443. Mechanistic methods for differential equation solution; application of analog or hybrid computers and digital differential analyzers for that purpose; design and structure of languages for digital-analog simulation on a general purpose digital computer: mimic language and examples of its use. Class will run simulation programs on a larger-scale computer.

ENEE 660 Modern Control System Design Method (3) Prerequisite: ENEE 663 and ENEE 620, or equivalent, or consent of the instructor. Applications of state space design methods; linear regulator problem and applications to tracking, stabilization and disturbance elimination; self-tuning regulators. State estimators. The second method of Liapunov and applications in contol systems design. Applications of modern frequency domain methods in control system design; diagonal dominance, dynamic compensation, decoupling. Applications of the linear quadratic Gaussian problem in control systems design. Case studies from industrial, guidance and other engineering control problems. Analysis of computer algorithms are analyzed for each of the above four basic design methods provided. Analysis of interactive computer aided design methods and validation procedures are extensively analyzed.

ENEE 661 Nonlinear Control Systems (3) Prerequisite: ENEE 460 or consent of instructor. State space methods of stability analysis including second order systems and the phase plane, linearization and stability in the small, stability in the large and Lyapunov's second method. Frequency domain methods including the describing function. Popov's method and functional analytic methods. Introduction to Volterra series representations of nonlinear systems. Applications to control system design.

ENEE 662 Sampled-Data Control Systems (3) Prerequsite: Preparations in linear feedback control theory or consent of instructor. Z-transform and modified z-transform method of analysis, root locus and frequency response methods of analysis, ideal and finite width sampling, discrete and continuous compensation of digital control systems, state space equations, controllability and observability of discrete systems, stability, minimum time and minimum energy control, statistical design and the discrete Kalman filter.

ENEE 663 System Theory (3) General systems models. State variables and state spaces. Differential dynamical systems. Discrete time systems. Linearity and its implications. Controllability and observability. State space structure and representation. Realization theory and algorithmic solutions. Parameterizations of linear systems; canonical forms. Basic results from stability theory. Stabilizability. Fine structure of linear multivariable systems; minimal indices and polynomial matrices. Inverse Nyquist array. Geometric methods in design. Interplay between frequency domain and state space design methods. Interactive computer-aided design methods. (Listed also as MAPL 640)

ENEE 664 Optimal Control (3) Prerequisite: ENEE 460 or consent of the instructor. General optimization and control problems. Static optimization problems. Linear and nonlinear programming methods. Geometric interpretations. Dynamic optimization problems. Discrete time maximum principle and applications Pontryagin maximum principle in continuous time. Dynamic-programming. Feedback realization of solutions. Extensive applications to problems in optimal design, navigation and guidance, power systems. Introduction to state constrained and singular optimal control problems. (Listed also as MAPL 641.)

ENEE 665 Linear System Identification (3) Prerequisite: MATH 400 and ENEE 322 or equivalent. ENEE 620. Representations for linear systems. Parameter estimation techniques such as least square and maximum likelihood. Correlation methods with white noise inputs. Stochastic approximation and gradient algorithms. Applications of quarilinearization and invariant imbedding. Effect of abrevation noise.

ENEE 680 Electromagnetic Theory I (3) Prerequisite: ENEE 381 or equivalent. Theoretical analysis and engineering applications of Maxwell's equations. Boundary value problems of electrostatics and magnetostatics.

ENEE 681 Electromagnetic Theory II (3) Prerequisite: ENEE 381 or equivalent. Continuation of ENEE 680. Theoretical analysis and engineering applications of Maxwell's Equations. The homogeneous wave equation. Plane wave propgation. The interaction of plane waves and material media. Retarded potentials. The Hertz potential. Simple radiating systems. Relativisitic covariance of Maxwell's Equations.

ENEE 686 Charged Particle Dynamics, Electron and Ion Beams (3) Three hours per week. Prerequisite: Consent of instructor. General principles of single-particle dynamics; mapping of the electric and magnetic fields; equation of motion and methods of solution; production and control of charge particle beams; electron optics; Liouville's Theorem; space charge effects in high current beams; design principles of special electron and ion beam devices.

ENEE 690 Quantum and Wave Phenomena with Electrical Application (3) Two lectures per week. Prerequisite: ENEE 381 and ENEE 382 or equivalent. Introduction of quantum and wave phenomena from electrical engineering point of view Topics included: general principles of quantum mechanics, operator algebra, the microwave resonant cavity and the analagous potential well problem, harmonic oscillator, hydrogenic atom. Perturbation method applied to the transmission line and potential well problems. Periodically loaded transmission line and Kronig-Penny model of band theory.

ENEE 696 Integrated and Milowave Electronics (3) cr Prerequisite: ENEE 310. Registration in ENEE 793 recommended. Active and passive elements used in semiconductor structures. Design application of linear and digital integrated circuits.

ENEE 697 Semiconductor Devices and Technology (3) Prerequisite: ENEE 496 or equivalent. Registration in ENEE 793 recommended The principles, structures and characteristics of semiconductor devices. Technology and fabrication of semiconductor devices.

ENEE 700 Network Synthesis (3) Prerequisite: ENEE 605 or equivalent. Design of driving-point and transfer impedance functions with emphasis of the transfer loss and phase of minimum-phase networks, flow diagrams, physical network characteristics, including relations existing between the real and imaginary components of network functions, modern methods of network synthesis.

ENEE 701 Network Synthesis (3) Prerequisite: ENEE 700 or equivalent. Design of driving-point and transfer impedance functions with emphasis of the transfer loss and phase of minimum-phase networks, flow diagrams, physical network characteristics, including relations existing between the real and imaginary components of network functions, modern methods of network synthesis.

ENEE 703 Semiconductor Device Models (3) Prerequisite: ENEE 605 or equivalents. Single-frequency models for transistors; small-signal and wide-band models for general non-reciprocal devices, hybrid-PI and TEE models for transistors; relationship of models to transistor physics; synthesis of wide-band models from terminal behavior, computer utilization of models for other semiconductor devices.

ENEE 721 Information Theory (3) Corequisite: ENEE 620. Prerequisite: STAT 400 or equivalent. Information measure, entropy, mutual information; source encoding; noiseless coding theorem, noisy coding theorem; exponential error bounds; introduction to probabilistic error correcting codes, block and convolutional codes and error bounds; channels with memory; continuous channels; rate distortion function. (Same as MAPL 731.)

ENEE 722 Error Correcting Codes (3) Introduction to linear codes; bounds on the error correction capabilities of codes; convolutional codes with threshold, sequential and Viterbi decoding; cyclic random error correcting codes; P-N sequences; cyclic and convolutional burst error correcting codes.

ENEE 724 Digital Signal Processing (3) Prerequisite: ENEE 620 or consent of instructor. Review of z transforms; correlations functions and power spectral densities for discrete time stochastic processes: discrete time Wiener filters; methods for designing digital filters to meet precise frequency domain specification; effects of truncation, round-off and finite word length arithmetic on the accuracy and stability of digital filters; adaptive equalizers for narrow band data channels; discrete Fourier transform and fast Fourier transform; homomorphic filtering; Gauss-Markov estimates; spectral density estimation.

ENEE 728 Advanced Topics in Communication Theory (3) Topics selected, as announced, from advanced communication theory and its applications.

ENEE 730 Advanced Topics—Radar Signals and Systems (3) Prerequisite: ENEE 620 or equivalent. The theory of imaging radar systems. Classifications, resolution mechanisms, and principles. System design for additive noise: effects of ambiguity, multiplicative noise, motion errors, nonlinearities, and scattering mechanism. System design for ambiguity and multiplicative noise. Optical processing Application to synthetic aperture, astronomical, and hologram radar.

ENEE 733 Neural Control of Animal Movement (3) Prerequisite: ENEE 633 or 634. Properties of muscles, proprioceptors, reflexes, and central nervous system structures; linear and nonlinear models; field potential analysis and theories of cerebellar function; and the control and coordination of these structures during voluntary and involuntary movement in animals.

ENEE 746 Digital Systems Engineering (3) Prerequisite: ENEE 646. Systems aspects of digital-computer-based systems; data flow analysis; system organization; control languages; consoles and displays; remote terminals; software-hardware tradeoff; system evaluation; case studies from selected applications areas such as data acquisition and reduction information storage, or the like.

ENEE 748 Topics in Computer Design (1–3) Prerequisite: Permission of the instructor Such topics as computer arithmetic, computer reliability, and threshold logic will be considered. May be taken for repeated credit.

ENEE 760 Mathematical Methods in Control Engineering (3) Prerequisite: ENEE 663 or consent of instructor. Applications of compactness in control and communication, geometric methods in optimal control of lumped and distributed systems and harmonic analysis of linear systems. Applications to control and estimation problems. (Listed also as MAPL 740.)

ENEE 761 Control of Distributed Parameter Systems (3) Prerequisite: An introductory course in functional analytic methods at the level of ENEE 760, and background in control and system theory. Study of systems governed by partial differential equations. Delay systems. Boundary and distributed control, Lyapunov stability. optimal control of systems governed by partial differential equations and of delay systems. Applications to continuum mechanics, distributed networks, biology, economics, and engineering. (Same as MAPL 741.)

ENEE 762 Stochastic Control (3) Prerequisites: ENEE 620 or equivalent; and ENEE 663/MAPL 640; or consent of the instructor. Stochastic control systems, numerical methods for the Ricatti Equation, the

separation principle, control of linear systems with Gaussian signals and quadratic cost, non-linear stochastic control, stochastic stability, introduction to stochastic games. (Same as MAPL 742.)

ENEE 769 Advanced Topics in Control Theory (3) Topics selected, as announced, from advanced control theory and its applications.

ENEE 772 Advanced Methods and Algorithms in Detection and Filtering (3) Prerequisite: ENEE 621. Foundations of random processes. Conditional expectations. Markov processes and Martingales. ITO calculus. Detection and estimation of continuous signals with continuous observations. Jump processes. Detection and estimation with discontinuous observations. Discrete-time case. Fast algorithms for digital filtering problems. (Listed also as MAPL 735.)

ENEE 774 Mathematics of Continuous Networks (3) Nonoriented systems, ports, linear orientations, theory of distributions, scattering matrices, operator theory of networks, activity, invariant embedding, multivariable PR and BR state-determined systems, synthesis, interval functions, tolerance analysis, neuron networks and models, Manley-Rowe relations, oscillators and nonlinear subharmonic generation.

ENEE 780 Microwave Engineering (3) Prerequisite: ENEE 681. Mathematical methods for the solution of the wave equation, transmission lines and waveguides, selected topics in the theory of waveguide structures, surface guides and artificial dielectrics.

ENEE 781 Optical Engineering (3) Fourier analysis in two dimensions, diffraction theory, optical imaging systems, spatial filtering, holography.

ENEE 782 Radio Wave Propagation (3) Two lectures per week. Prerequisite: ENEE 681. General solutions of Maxwell's Equations, geometrical optics approximations, propagation above a plane earth, effects of surface irregularities and stratified atmospheres, scattering by turbulence.

ENEE 784 Antenna Theory (3) Two lectures per week. Prerequisite: ENEE 681 or equivalent. Review of Maxwell's Equations; radiative networks; linear antennas; antenna arrays; aperture antennas; advanced topics.

ENEE 790 Quantum Electronics I (3) Two lectures per week. Prerequisite: A knowledge of quantum mechanics and electromagnetic theory. Spontaneous emission, interaction of radiation and matter, masers, optical resonators, the gas, solid and semi-conductor lasers, electro-optical effect, propagation in anisotropic media and light modulation.

ENEE 791 Quantum Electronics II (3) Nonlinear optical effects and devices, tunable coherent light sources: optical parametric oscillator; frequency conversion and dye laser. Ultrashort pulse generation and measurement, stimulated Raman effect, and applications. Interaction of acoustic and optical waves, and holography.

ENEE 793 Solid State Electronics (3) Prerequisite: A graduate course in quantum mechanics or consent of instructor. Properties of crystals; energy bands: electron transport theory; conductivity and hall effect; statistical distributions; Fermi level: impurities; non-equilibrium carrier distributions; normal modes of vibration; effects of high electric fields; P-N junction theory, avalanche breakdown; tunneling phenomena; surface properties.

ENEE 799 Master's Thesis Research (1–6)

ENEE 899 Doctoral Dissertation Research (1–8)

Engineering Materials Program

Professor and Acting Director: Dieter[2]
Professor and Department Chairman: Cadman[1]
Professors: Armstrong[3], Arsenault[1],
Adjunct Professor: Kramer
Assistant Professor: Mathers[1]
Associate Faculty: Marcinkowski[3], Park[4]

[1]Chemical and Nuclear Engineering
[2]Dean, College of Engineering
[3]Mechanical Engineering
[4]Physics and Astronomy

The Engineering Materials program is interdisciplinary between Chemical and Mechanical Engineering. It is administered by the Department of Chemical and Nuclear Engineering. Special areas of concentration include diffraction, dislocation and mechanical behavior of materials, x-ray and electron microscopic techniques, electronic and magnetic behavior of materials, and the chemical physics of materials.

Admission and Degree Information

The programs leading to the M.S. and Ph.D. degrees are open to qualified students holding the B.S. degree. Admission may be granted to students with degrees in any of the engineering and science areas from accredited programs. In some cases it may be necessary to require courses to fulfill the back ground. The candidate for the M.S. degree has the choice of following a plan of study with thesis or without thesis. The equivalent of at least three years of full-time study beyond the B.S. degree is required for the Ph.D. degree. All students seeking graduate degrees in Engineering Materials must enroll in ENMA 650, 660 and 671. In addition to the general rules of the Graduate School certain special degree requirements are set forth by the Department in their departmental publications.

Facilities and Special Resources

Special equipment available includes a scanning electron microscope, x-ray diffraction equipment, crystal growing, sample preparation and mechanical testing facilities, and high pressure and cryogenic equipment.

Additional Information

Information is available from the Director, Engineering Materials Program, Department of Chemical and Nuclear Engineering.

Courses

ENMA 462 Deformation of Engineering Materials. (3) Prerequisites:ENES 230 or consent of instructor. Relationship of structure to the mechanical properties of materials. Elastic and plastic deformation, microscopic yield criteria, state of stress and ductility. Elements of dislocation theory, work hardening, alloy strengthening, creep, and fracture in terms of dislocation theory.

ENMA 463 Chemical, Liquid and Powder Processing of Engineering Materials. (3) Prerequisites: ENES 230 or consent of instructor. Methods and processes used in the production of primary metals. The detailed basic principles of beneficiation processes, pyrometallurgy, hydrometallurgy, electrometallurgy, vapor phase processing and electroplating. Liquid metal processing including casting, welding, brazing and soldering. Powder processing and sintering. Shapes and structures produced in the above processes.

ENMA 464 Environmental Effects on Engineering Materials. (3) Prerequisites: ENES 230 or consent of instructor. Introduction to the phenomena associated with the resistance of materials to damage under severe environmental conditions. Oxidation, corrosion, stress corrosion, corrosion fatigue and radiation damage are examined from the point of view of mechanism and influence on the properties of materials. Methods of corrosion protection and criteria for selection of materials for use in radiation environments.

ENMA 470 Structure and Properties of Engineering Materials. (3) A comprehensive survey of the atomic and electronic structure of solids with emphasis on the relationship of structure to the physical and mechanical properties.

ENMA 471 Physical Chemistry of Engineering Materials. (3) Equilbrium multicomponent systems and relationship to the phase diagram. Thermodynamics of polycrystalline and polyphase materials. Diffusion in solids, kinetics of reactions in solids.

ENMA 472 Technology of Engineering Materials. (3) Relationship of properties of solids to their engineering applications. Criteria for the choice of materials for electronic, mechanical and chemical properties. Particular emphasis on the relationships between structure of the solid and its potential engineering application.

ENMA 473 Processing of Engineering Materials. (3) The effect of processing on the structure of engineering materials. Processes considered include refining, melting and solidification, purification by zone refining, vapor phase processing, mechanical working and heat treatments.

ENMA 495 Rheology of Engineering Materials. (3) Prerequisites: ENES 230 or consent of instructor. Study of the deformation and flow of engineering materials and its relationship to structural type. Elasticity, viscoelasticity, anelasticity and plasticity of single phase and multiphase materials. Students who have credit for ENMA 495 may not take ench 495 for credit.

ENMA 496 Polymeric Engineering Materials. (3) Prerequisite: ENES 230. A comprehensive summary of the fundamentals of particular interest in the science and applications of polymers. Polymer single crystals, transformations in polymers, fabrication of polymers as to shape and internal structure. Students who have credit for ENMA 496 may not take ENCH 496 for credit.

ENMA 650 Structure of Engineering Materials. (3) Prerequisite: ENMA 470 or equivalent. The structural aspects of crystalline and amorphous solids and relationships to bonding types. Point and space groups. Summary of diffraction theory and practice. The reciprocal lattice. relationships of the microscopically measured properties to crystal symmetry. Structural aspects of defects in crystalline solids.

ENMA 651 Electronic Structure of Engineering Materials. (3) Prerequisite: ENMA 650. Electronic and magnetic materials in relationship to their applications. Metallic conductors, resistive alloys, superconducting materials, semiconductors, hard and soft magnetic materials, piezo-electric and piezo-magnetic materials, optical materials. Emphasis on relationships between electronic configuration, crystal structure, defect structure and physical properties.

ENMA 659 Special Topics in Structure of Engineering Materials. (3) Prerequisite: consent of instructor.

ENMA 660 Chemical Physics of Engineering Materials. (3) Prerequisite: ENMA 650 Thermodynamics and statistical mechanics of engineering solids. Cohesion, thermodynamic properties. Theory of solid solutions. Thermodynamics of mechanical, electrical, and magnetic phenomena in solids. Chemical thermodynamics, phase transitions and thermodynamic properties of polycrystalline and polyphase materials. Thermodynamics of defects in solids.

ENMA 661 Kinetics of Reactions in Materials. (3) Prerequisite: ENMA 660. The theory of thermally activated processes in solids as applied to diffusion, nucleation and interface motion. Cooperative and diffusionless transformations. Applications selected from processes such as all otropic transformations, precipation, martensite formation, solidification, ordering, and corrosion.

ENMA 669 Special Topics in the Chemical Physics of Materials. (3) Prerequisite: consent of instructor.

ENMA 671 Dislocations in Crystalline Materials. (3) cr Prerequisite: ENMA 650. The nature and interactions of defects in crystalline solids, with primary emphasis on dislocations. The elastic and electric fields associated with dislocations. Effects of imperfections on mechanical and physical properties.

ENMA 672 Mechanical Properties of Engineering Materials. (3) Prerequisite: ENMA 671. The mechanical properties of single crystals, polycrystalline and polyphase materials. Yield strength, work hardening, fracture, fatigue and creep are considered in terms of fundamental material properties.

ENMA 679 Special Topics in the Mechanical Behavior of Materials. (3) Prerequisite: consent of instructor.

ENMA 680 Experimental Methods in Materials Science. (3) Methods of measuring the structural aspects of materials. Optical and electron microscopy. Microscopic analytical techniques. Resonance methods. Electrical, optical and magnetic measurement techniques. Thermodynamic methods.

ENMA 681 Diffraction Techniques in Materials Science. (3) Prerequisite: ENCH 620. Theory of diffraction of electrons, neutrons and x-rays. Strong emphasis on diffraction methods as applied to the study of defects in solids. Short range order, thermal vibrations, stacking faults, microstrain.

ENMA 689 Special Topics in Experimental Techniques in Materials Science. (3) Prerequisite: consent of instructor.

ENMA 691 Special Topics in Engineering Materials. (3) Prerequisite: consent of instructor.

ENMA 697 Seminar in Engineering Materials. (1)

ENMA 698 Special Problems in Engineering Materials. (1–6)

ENMA 799 Master's Thesis Research. (1–6)

ENMA 899 Doctoral Dissertation Research. (1–8)

English Language and Literature Program

Professor and Acting Chairman: Patterson
Professors: Bode, Bradley, Bryer, Freedman, Holton Hovey, Kenny, Kinnaird Isaacs, Lawson, Lutwack, Mish, Myers, Panichas, Patterson, Peterson, Russell, Salamanca, Schoenbaum, Vitzthum Whittemore, Winton, Wittreich
Associate Professors: Barnes, Barry, Birdsall, Brown, Coogan, Cooper, Fry, Greenwood, D. Hamilton, G. Hamilton, Herman, Howard, Jellema, Kleine, Mack, Ousby, Miller, Smith, Thorberg, Trousdale, Wilson
Assistant Professors: Burger, Cate, Coletti, Dunn, James, Rutherford, Van Egmond

The Department of English offers graduate work leading to the degrees of Master of Arts and Doctor of Philosophy. Areas of specialization for the M.A. and Ph.D. include: English literature, American literature, and folklore. In addition, candidates for the M.A. degree may specialize in creative writing, and in linguistics.

Admission and Degree Information

In addition to the general Graduate School requirements, applicants to the M.A. program ordinarily should present a 3.5 GPA in English and a minimum of 24 hours of upper-level English courses. Applicants to the Ph.D program should present a 3.75 GPA and an M.A. degree in English.

The Department requires 30 credits for the M.A. with thesis. These credits include ENGL 601 and a distribution requirement to assure coverage of the major historical fields. Candidates have a non-thesis option under which they take 31 credits, submit an independent research paper, and pass a three-hour written comprehensive examination.

Departmental requirements for the degree of Doctor of Philosophy include: (1) a foreign language requirement; (2) at least three hours of linguistics; (3) a comprehensive written examination on three fields (dissertation field and two additional fields) which may be begun after nine hours beyond the Master of Arts.

Facilities and Special Resources

In addition to drawing on the cultural and intellectual resources of Washington, D.C., the English department is an active participant in the Folger Institute of Renaissance and 18th Century Studies. Folger Institute fellowships have been awarded to advanced graduate students in the English department.

The Department is also a member of South Atlantic Graduate English (SAGE). Graduate students from Maryland may take courses at other SAGE institutions, and the English department is eligible for a lecturer of its choice from another SAGE institution.

Financial Assistance

Financial assistance is available in the form of fellowships and teaching assistantships. Fellowships are awarded directly by the Graduate School to nominees from the English department. The number of teaching assistantships is contingent on available funds; currently 96 students are teaching assistants.

Additional Information

Additional information on admission, financial aid, and degree requirements can be obtained from Calhoun Winton, Director of Graduate Studies, Department of English, University of Maryland.

Courses

ENGLISH

ENGL 402 Chaucer. (3)

ENGL 403 Shakespeare. (3) Early period—histories and comedies.

ENGL 404 Shakespeare. (3) Late periods—tragedies and romances.

ENGL 407 Literature of the Renaissance. (3)

ENGL 410 Edmund Spenser. (3) cr

ENGL 411 Literature of the Renaissance. (3)

ENGL 412 Literature of the Seventeenth Century, 1600–1660. (3)

ENGL 414 Milton. (3)

ENGL 415 Literature of the Seventeenth Century, 1660–1700. (3)

ENGL 416 Literature of the Eighteenth Century. (3) Age of Pope and Swift.

ENGL 417 Literature of the Eighteenth Century. (3) Age of Johnson and the preromantics.

ENGL 418 Major British Writers. (3) Two writers studied intensively each semester.

ENGL 419 Major British Writers. (3) Two writers studied intensively each semester.

ENGL 420 Literature of the Romantic Period. (3) First generation: Blake, Wordsworth, Coleridge, et. al.

ENGL 421 Literature of the Romantic Period. (3) Second generation: Keats, Shelly, Byron, et. al.

ENGL 422 Literature of the Victorian Period. (3) Early years.

ENGL 423 Literature of the Victorian Period. (3) Middle years.

ENGL 424 Late Victorian and Edwardian Literature. (3) A study of the literary movements and techniques which effected the transition from Victorian to modern literature.

ENGL 425 Modern British Literature. (3) An historical survey of the major writers and literary movements in English prose and poetry since 1900.

ENGL 430 American Literature, Beginning to 1810, the Colonial and Federal Periods. (3)

ENGL 431 American Literature, 1810 to 1865, the American Renaissance. (3)

ENGL 432 American Literature, 1865 to 1914, Realism and Naturalism. (3)

ENGL 433 American Literature, 1914 to the Present, the Modern Period. (3)

ENGL 434 American Drama. (3)

ENGL 435 American Poetry—Beginning to the Present. (3)

ENGL 436 The Literature of American Democacy. (3) cr

ENGL 437 Contemporary American Literature. (3) A survey of the poetry, prose, and drama written in America in the last decade.

ENGL 438 Major American Writers. (3) Two writers studied intensively each semester.

ENGL 439 Major American Writers. (3) Two writers studied intensively each semester.

ENGL 440 The Novel in America to 1910. (3)

ENGL 441 The Novel in America Since 1910. (3)

ENGL 442 Literature of the South. (3) A historical survey, from Eighteenth-century beginnings to the present.

ENGL 443 Afro-American Literature. (3) An examination of the literary expression of the Negro in the United States, from its beginning to the present.

ENGL 444 Experimental Approaches to Literature—Emerson and Thoreau. (3) Variable subject matter presented in experimental methods and approaches. Grading in satisfactory/fail only. Consent of instructor required for admission.

ENGL 445 Modern British and American Poetry. (3) Prerequisite: permission of instructor required for students with credit in ENGL 345. A study of the formation of the 'modern tradition' in British and American poetry, exploring the distinctive energy and consciousness in the poets of the early Twentieth Century (1896–1930). Special emphasis on Hopkins, Yeats, Pound, Eliot, and Stevens. Collateral readings in essays on modern poetics, and in other poets of the period.

ENGL 446 Contemporary British and American Poetry. (3) Prerequisite: permission of instructor required for students with credit in ENGL 345. A study of British and American poetry from the depression to the present. Special emphasis on Auden, Williams, Dylan Thomas, Theodore Roethke, Robert Lowell. A more general study of the work of some of these: Berryman, Jarrell, Fuller, Bishop, Wright, Kinnell, Larkin and including the Projectivists, the Beats and the present scene.

ENGL 447 Satire. (3) An introduction to English and American satire from Chaucer to the present.

ENGL 449 Playwriting. (3)

ENGL450 Elizabethan and Jacobean Drama. (3) Beginnings to Marlowe.

ENGL 451 Elizabethan and Jacobean Drama. (3) Jonson to Webster.

ENGL 452 English Drama from 1660 to 1800. (3)

ENGL 453 Literary Criticism. (3)

ENGL 454 Modern Drama. (3) cr

ENGL 455 The English Novel. (3) Eighteenth Century.

ENGL 456 The English Novel. (3) Nineteenth Century.

ENGL 457 The Modern Novel (3)

ENGL 461 Folk Narrative (3) Studies in legend, tale and myth. Prerequisite: ENGL 460.

ENGL 462 Folksong and Ballad (3) Prerequisite: ENGL 460.

ENGL 463 American Folklore. (3) Prerequisite: ENGL 460. An examination of American folklore in terms of history and regional folk cultures. Exploration of collections of folklore from various areas to reveal the difference in regional and ethnic groups as witnessed in their oral and literary traditions.

ENGL 464 Afro-American Folklore and Culture. (3) An examination of the culture of the Negro in the United States in terms of history (antebellum to the present) and social changes (rural to urban). Exploration of aspects of Negro culture and history via oral and literary traditions and life histories.

ENGL 465 Urban Folklore. (3) Prerequisite: ENGL 460. An examination of the folklore currently originating in white, urban, American culture.

ENGL 466 Arthurian Legend. (3) Development of the Arthurian legend of heroism and love in English literature from medieval to modern times.

ENGL 474 Literature for Children (3) Analysis of nineteenth and twentieth century classics of the genre.

Relation of this literature to the forming of future literary perceptions.

ENGL 475 Literature for Adolescents. (3) Adolescent themes in contemporary and older literature designed for adolescent and young adult audiences.

ENGL 476 Modern Fantasy and Science Fiction. (3) Major works of fantasy and science fiction since the mid-eighteenth century, emphasizing their continuity and their relationships to philosophical speculation, scientific discovery, literary history and cultural change.

ENGL 478 Selected Topics in English and American Literature before 1800. (3)

ENGL 479 Selected Topics in English and American Literature after 1800. (3)

ENGL 481 Introduction to English Grammar. (3) A brief review of traditional English grammar and an introduction to structural grammar, including phonology, morphology and syntax.

ENGL 482 History of the English Language. (3)

ENGL 483 American English. (3)

ENGL 484 Advanced English Grammar. (3) Credit may not be granted in both ENGL 484 and LING 402.

ENGL 486 Introduction to Old English. (3) An introduction to the grammar, syntax, and phonology of Old English. Selected readings from Old English prose and poetry.

ENGL 489 Special Topics in English Language. (3) Studies in topics of current interest; repeatable to a maximum of 9 hours.

ENGL 493 Advanced Expository Writing. (3)

ENGL 498 Creative Writing. (3) cr

ENGL 499 Advanced Creative Writing. (3)

ENGL 601 Bibliography and Methods. (3)

ENGL 602 Middle English. (3)

ENGL 603 Readings in English Language History. (3) An historical survey of the syntactic, lexical, and phonological patterns of English from Old English and its sources in Germanic and Indo-European through modern English.

ENGL 604 Old English. (3) Grammar, syntax, phonology and prosody of Old English. designed to give graduate students a working knowledge of Old English and to introduce them to the major Old English texts in the original.

ENGL 611 Approaches to College Composition. (3) A seminar emphasizing rhetorical and linguistic foundations for the handling of a course in freshman composition. For graduate assistants (optional to other graduate students).

ENGL 620 Readings in Medieval English Literature. (3)

ENGL 621 Readings in Renaissance English Literature. (3)

ENGL 622 Readings in Seventeenth—Century English Literature. (3)

ENGL 623 Readings Eighteenth-Century English Literature. (3)

ENGL 624 Readings in English Romantic Literature. (3)

ENGL 625 Readings in English Victorian Literature. (3)

ENGL 626 Readings in American Literature before 1865. (3)

ENGL 627 Readings in American Literature since 1865. (3)

ENGL 630 Readings in 20th Century English Literature. (3)

ENGL 699 Independent Study. (1–3) cr Prerequisite: departmental approval of research project and consent of the instructor.

ENGL 718 Seminar in Medieval Literature. (3)

ENGL 719 Seminar in Renaissance Literature. (3)

ENGL 728 Seminar in Seventeenth-Century Literature. (3)

ENGL 729 Seminar in Eighteenth-Century Literature. (3)

ENGL 738 Seminar in Nineteenth-Century Literature. (3)

ENGL 739 Seminar in Nineteenth-Century Literature. (3)

ENGL 748 Seminar in American Literature. (3) cr

ENGL 749 Studies in Twentieth-Century Literature. (3)

ENGL 758 Literary Criticism. (3)

ENGL 759 Seminar in Literature and the Other Arts. (3)

ENGL 768 Studies in Drama. (3)

ENGL 769 Studies in Fiction. (3)

ENGL 778 Seminar in Folklore. (3)

ENGL 788 Studies in the English Language. (3) May be repeated for credit to a maximum of 9 hours.

ENGL 799 Master's Thesis Research. (1–6)

ENGL 819 Seminar in Themes and Types in English Literature. (3)

ENGL 828 Seminar in Themes and Types in American Literature. (3)

ENGL 899 Doctoral Dissertation Research. (1–8)

Entomology Program

Professor and Chairman: Steinhauer
Professors: Baker, Batra, Caron, Davidson, Harrison, Jones, Knutson, Menke, Menzer, Messersmith, Wirth
Associate Professors: Barbosa, Denno, Miller, Reichelderfer, Wood
Assistant Professors: Armstrong, Dively, Grissell, Hellman, Mellors, Nelson Opler
Lecturer: Marsh, Spangler
Professor Emeritus: Bickley

The Department of Entomology offers both the M.S. and Ph.D. degrees. Graduate students may specialize in physiology and morphology, toxicology, biosystematics, ecology and behavior, medical entomology, apiculture, insect pathology, economic entomology and pest management.

Admission and Degree Information

Students applying for graduate work in entomology are expected to have strong backgrounds in the biological sciences, chemistry and mathematics. Since the Department is particularly anxious to find strong basic preparation, an undergraduate major in entomology is not required for admission to the program. Students lacking certain specific courses in their undergraduate program may need to extend the normal period of time required for the degree.

In the M.S. and Ph.D. programs, the student is given great latitude in the selection of the advisory study committee, choice of the major study areas and supporting course work and choice of the research program. The M.S. degree is awarded following the successful completion of the course requirements and a satisfactory thesis. A non-thesis M.S. option is available for those interested in qualifying as pest management specialists. In this program a field experience course including a comprehensive report is substituted for the thesis.

Upon admission to the M.S. or Ph.D. program, the student is given a written departmental examination to evaluate general knowledge of biology and entomology. After passing this examination the student's study committee suggests a program of course work and approves a detailed research proposal. Following completion of most course work and demonstration of competency in one foreign or computer language, the Ph.D. student is given an oral qualifying examination before applying for admission to candidacy.

Facilities and Special Resources

Facilities are maintained in the Department for research in all areas of specialization offered, and in addition, cooperative programs with other departments in Agricultural and Life Sciences are possible. Cooperative research programs are often maintained by the Department with several government agencies, such as the Beltsville Agricultural Research Center, The U.S. National Museum of Natural History, and the Walter Reed Army Institute of Research. Students may also participate in the Maryland Center for Sytematic Entomology where cooperative guidance toward advanced degrees has been established between the Department and scientists in the Insect Identification and Beneficial Insect Introduction Institute, S.E.A., U.S.D.A. and the Department of Entomology, Smithsonian Institution. Specialized facilities are frequently made available to graduate students in these programs. In many instances graduates of the programs in entomology find employment in such government agencies because of the contacts made in these cooperative projects.

Financial Assistance

There are a limited number of teaching and research assistantships available to entomology graduate students on a competitive basis. Several part-time employment opportunities are available in governmental and private research and developemental laboratories in the area.

Additional Information

The Department's "Guidelines for Graduate Students" gives additional information on the graduate program, including requirements for admission, course requirements, examinations, seminars and research areas and facilities. Copies are available from the Department of Entomology, University of Maryland.

Courses

ENTM 407 Entomology for Science Teachers. (4) Summer. Four lectures and four three-hour laboratory periods a week. This course will include the elements of morphology, taxonomy and biology of insects using examples commonly available to high school teachers. It will include practice in collecting, preserving, rearing and experimenting with insects insofar as time will permit.

ENTM 412 Advanced Apiculture. (3) One lecture and two three-hour laboratory periods a week. Prerequisite: ENTM 111. The theory and practice of apiary management. Designed for the student who wishes to keep bees or requires a practical knowledge of bee management.

ENTM 421 Insect Taxonomy and Biology. (4) Two lectures and two three-hour laboratory periods a week. Prerequisite: ENTM 204. Introduction to the principles of systematic entomology and the study of all orders and the important families of insects; immature forms considered.

ENTM 451 Insect Pests of Agricultural Crops. (4) Two lectures and two two-hour laboratory periods a week. Prerequisite: ENTM 204. The recognition, biology and control of insects injurious to fruit and vegetable crops, field crops and stored products.

ENTM 452 Insecticides. (2) Prerequisite: consent of the department. The development and use of contact and stomach poisons, fumigants and other important chemicals, with reference to their chemistry, toxic action, compatability, and host injury. Recent research emphasized.

ENTM 453 Insect Pests of Ornamentals and Turf. (3) Prerequisites: ENTM 204 or consent of instructor. Two lectures and one three-hour laboratory period a week. The recognition, biology and control of insects and mites injurious to ornamental shrubs, trees, green-

house crops, and turf. Emphasis on pests of woody ornamental plants.

ENTM 455 Urban Entomology. (3) Two lectures and one three-hour laboratory period a week. Prerequisite: ENTM 421 or consent of instructor. A study of the appearance, habits, life cycles and methods of control of pests of humans, pets and structures in the urban environment. Field observations of professional pest control operations and a paper on a selected pest group are required.

ENTM 472 Medical and Veterinary Entomology. (4) Three lectures and one two-hour laboratory period a week. Prerequisite: ENTM 204 or consent of department. A study of the morphology, taxonomy, biology and control of the arthropod parasites and disease vectors of man and animals. The ecology and behavior of vectors in relation to disease transmission will be emphasized.

ENTM 611 Biological Control of Insects and Weeds. (3) Biological control of insects and weeds. Two lectures and one three-hour laboratory period per week. Prerequisite: ENTM 421. A study of the principles and practices of the biological control of insect pests and weeds. Systematic laboratory study of entomophagous insects with emphasis on the parasitic wasps; collection required.

ENTM 612 Insect Ecology. (3) Prerequisite: a course in general ecology or permission of instructor. An advanced course in population and community ecology, plant-insect interactions, and insect biogeography. Emphasis on current entomological literature.

ENTM 622 Principles of Systematic Entomology. (3) Two lectures and one three-hour laboratory period a week. Prerequisite: ENTM 421. The principles of systematics including traditional classification methods, statistics, and numerical taxonomy. Nomenclature, continental drift, and speciation theory. A laboratory problem in systematics is required.

ENTM 625 Experimental Honey Bee Biology. (2) First semester. One three-hour lab a week. Fifteen labs during Semester will include topics such as communication, nest construction and organization, behavior, insect societies and bee and wasp biology.

ENTM 631 Insect Anatomy. (3) Two one-hour lectures and one three-hour laboratory per week. general organization and development of insects, the body wall and its derivatives, body regions, sclerites and segmentation, segmental appendages, head and its appendages, thorax, legs and wings, the abdomen, alimentary canal, organs of distribution, respiratory system, nervous system, sense organs, and the reproductive organs. Dissections of selected systems of a grasshopper.

ENTM 641 Advances in Insect Physiology. (3) Two lectures and one three-hour laboratory per week. Prerequisites: ENTM 322 and BCHM 261 or their equivalents, or consent of instructor. Lectures and laboratory exercises on the functioning of insect body systems, metabolism, neuro-physiology, endocrinology, and physiological ecology of insects.

ENTM 653 Toxicology of Insecticides. (4) First semester. Three lectures and one three-hour laboratory period a week. (Alternate years, not offered 1973–1974.) Prerequisite: permission of the instructor. A study of the physical, chemical, and biological properties of insecticides. Emphasis is placed on the relationship of chemical structures to insecticidal activity and mode of action. Mechanisms of resistance are also considered.

ENTM 654 Advanced Pest Management. (3) Three lectures a week. Prerequisite: consent of instructor. Current developments in pest management theory and practice. Emphasis on agro-ecosystem components and their manipulation. Biological and environmental monitoring, decision-making, cost-benefit relationships, and pest management modeling in major cropping systems.

ENTM 662 Insect Pathology. (3) Three lectures with directed independent laboratory study. Prerequisite: MICB 200, pre- or corequisite: ENTM 641 or consent of the instructor. An examination of primarily insect pathogens with special reference to symptomology, epizootiology and mode of action, and the microbial control of insect pests.

ENTM 672 Culicidology. (2) Second semester. One lecture and one three-hour laboratory period a week. (Alternate years.) The classification, distribution, ecology, biology, and control of mosquitoes.

ENTM 699 Advanced Entomology. (1–6) Credit and prerequisites to be determined by the department. First and second semesters. Studies of minor problems in morphology, physiology, taxonomy and applied entomology, with particular reference to the preparation of the student for individual research.

ENTM 722 Biology and Taxonomy of Aquatic Insects. (4) Biology and taxonomy of aquatic insects. One four-hour lecture and laboratory combined per week. Prerequisite: ENTM 421. Fifteen Saturday labs per semester will include the morphology, biology, and taxonomy of adult and immature insects living in water.

ENTM 723 Taxonomy of Larval Insects. (2) Taxonomy of larval insects. One lecture and one two-hour laboratory period a week. Prerequisite: ENTM 421 and consent of instructor. A study of the identification and biology of larval insects. A collection is required.

ENTM 725 Acarology. (3) Two lectures and one three-hour laboratory period a week. Prerequisite: consent of instructor. Introduction to the taxonomy and biology of mites and ticks. Emphasis on the recognition of adult females at the family level. Consideration of adult males and immatures. A collection of slide mounted specimens is required.

ENTM 728 Advanced Systematics of Selected Orders. (1–3) Advanced systematics of selected orders. One lecture or one three-hour laboratory a week for each credit hour. Prerequisite: consent of department. Lectures and laboratory sessions on the systematics of selected major insect orders such as coleoptera, lepidoptera, diptera, and hymenoptera, or groups of minor orders.

ENTM 743 Aspects of Insect Biochemistry. (2) First semester. Two lectures a week. (Alternate years) One year of biochemistry, or equivalent, or consent of the instructor. Lectures and group discussions of the energy sources of insects. Intermediary metabolism, utilization of energy sources, specialized subjects of current interest, such as light production, insect pigment formation, pheromones, venoms, and chemical defense mechanisms.

ENTM 788 Entomological Topics. (1–3) One lecture or one two-hour laboratory period a week for each credit hour. Prerequisite: consent of department. Lectures, group discussions or laboratory sessions on selected topics such as: aquatic insects, biological control of insects, entomological literature, forest entomology, history of entomology, insect biochemistry, insect embryology, immature insects, insect behavior, insect communication, principles of entomological research.

ENTM 789 Field Experience in Pest Management. (1–6) Prerequisite, ENTM 654 or consent of the department. Involvement in practical problems of pest management in field situations. The student will be assigned to a problem area for intensive experience, usually during the summer. A final written report is required for each assignment. Repeatable to a maximum of six credits.

ENTM 798 Topic Seminar. (1) Discussion and presentation of current research and literature.

ENTM 799 Master's Thesis Research (1–6)

ENTM 899 Doctoral Dissertation Research. (1–8)

Family and Community Development Program

Professor and Chairman: Hanna
Professors: Clignet, Gaylin
Associate Professors: Myricks, Rubin, Wilson
Assistant Professors: Churaman, Macklin, Phillips, Tourigny, Valadez

The Department of Family and Community Development is devoted to describing, explaining, and improving the quality of life in urban, suburban, and rural areas by means of interdisciplinary research, education, community outreach, and public service. The curriculum places special emphasis upon the family and the community as mediating structures in determining life quality. The approach is holistic, i.e., human ecology. Departmental graduate training prepares students for jobs in research centers, consulting firms, voluntary organizations, federal, state, and local governments, and international organizations.

The Department offers a Master of Science degree with four specializations. Community Development is concerned with the processes and methods of local change, as well as individuals or groups as agents of change. Emphases include neighborhood revitalization, international community development, and the improvement of services to communities. Management and Consumer Studies focuses on the efficient utilization of available family and community resources, the relationship between available resources and governmental (and private sector) policies, and the development of expanded resources through citizen action. Family Studies stresses a working knowledge of the growth of individuals throughout the life span, with particular emphases on inter-generational aspects of family living and the effective delivery of family-oriented services. A cross-cultural perspective is employed. Family Therapy draws upon knowledge of family dynamics and change using the clinical techniques of therapy and consultation.

Admission and Degree Information

The Department employs the general policies of the graduate school as the basic criteria for admission to the Master's program. In addition, it is required that individuals take the Aptitude section of the GRE and have adequate undergraduate preparation in one or more of the following areas: anthropology, economics, geography, family development, planning, political science, psychology, public administration, social work, sociology, or urban studies. A course in elementary statistics at the undergraduate level is required.

The Master's program is 30 hours. The student may choose either the thesis or non-thesis option. A student selecting the thesis option is required to enroll for six hours of thesis research. For the non-thesis option, a student will complete 30 hours of course work and take oral and written comprehensive examinations.

Financial Assistance

Due to the limited number of available Graduate Teaching Assistantships, and the high demand, application for financial aid should be made prior to April 1st for the Fall semester of the coming year.

Additional Information

Further information regarding this program should be obtained by contacting the Department directly.

Courses

FMCD 430 Gender Role Development in the Family. (3) Prerequisite: FMCD 260. The development of masculinity and femininity within the context of the contemporary family and the implications for family life.

FMCD 431 Family Crises and Rehabilitation. (3) Deals with various types of family crises situations and how families cope with the rehabilitation process. It covers issues at various stages of the family cycle ranging from divorce, teenage runaways, abortion, to the effect of death on a family. Role playing and interviewing techniques are demonstrated and ways of helping the family through the crises are emphasized.

FMCD 432 Intergenerational Aspects of Family Living. (3) Prerequisites: FMCD 105, 260 and 332, or permission of instructor. The historical, cultural, developmental, and psychosocial experiences of contemporary American generations. Interactions among different generations within the family and consequences for individual development.

FMCD 443 Consumer Problems. (3) Consumer practices of American families. Merchandising practices as

they affect the consumer. Organizations and laws in the interest of the consumer.

FMCD 446 Living Experiences with Families. (3–6) A—Domestic Intercultural B—International Intercultural Prerequisites: FMCD 330, ANTH 101; FMCD 250; optional, language competence. An individual experience in living with families of a sub-culture within the U.S. or with families of another country, participating in family and community activities. A foreign student may participate and live with an American family.

FMCD 447 Home Management for the Disabled. (3) Application of home management concepts in the use of resources to promote maintenance of homemaker independence through physiological and psychological adjustments in the family and home environment. The purpose of this course is to prepare students for working effectively with disabled homemakers.

FMCD 448 Selected Topics in Home Management. (3) Seminar format will be used to examine the ways families set priorities and organize their efforts and resources to achieve both social and economic goals. Prior registration in FMCD 250, 341, or other courses in management theory, systems analysis or research methods is desirable. Repeatable for a maximum of 6 credits provided subject matter is different.

FMCD 453 Family-Community Advocacy. (3) Prerequisite: FMCD 201 or permission of instructor. Decision-making processes at the federal, state and local levels regarding social policy determination in the family and community field. The origins and consequences of policies as they affect family and community functioning.

FMCD 460 Violence in the Family. (3) Prerequisites: FMCD 260 or 330 or 332. Violence in the family from the perspective of interfamilial patterns and systems. The ways in which societal forces augment, support or deter violent interchanges.

FMCD 483 Family and Community Service Systems. (3) Prerequisite: by permission of instructor. The planning, implementation, administration, and evaluation of human service systems affecting families and communities. Major organizational theories, managerial styles, administrative techniques, and relevant issues in human service delivery.

FMCD 485 Introduction to Family Counseling. (3) Provides the fundamental theoretical concepts and clinical procedures that are unique to marital and family therapy. These techniques are contrasted with individually-orientated psychotherapy. Pre-marital, marital and family, and divorce counseling techniques are demonstrated and evaluated.

FMCD 487 Legal Aspects of Family Problems. (3) Laws and legal involvement that directly affect specific aspects of the family: adoption, marriage, estate planning, property rights, wills, etc. Emphasis will be given to the involvement of a professional lawyer; principles and interpretation of the law.

FMCD 499 Special Topics. (1–3) A—Family Studies B—Community Studies C—Management and Consumer Studies

FMCD 600 Readings in Research and Theory of the Family. (3) Emphasis is placed on surveying current research, concepts and theory in marital and family dynamics. The relationship of the contemporary family to the society and community are discussed and family patterns within various social classes and across different cultures are compared. Changes in family functioning throughout the family life cycle and over the last hundred years are described and analyzed.

FMCD 602 Integrative Aspects of Family and Community Development (3) Integrative approach to studying and improving the quality of life, drawing upon family, consumer, and community studies.

FMCD 605 Community Development in Neighborhoods (3) Exploration of neighborhoods in cities and suburbs, as well as small towns, including their varying character, their dynamics of change, and the possibility of community development.

FMCD 609 Seminar: Current Issues in Family and Community Development. (1–4) This seminar will be open to all graduate students for non-credit or variable credit by prior arrangement. It is considered an informal vehicle to generate communication and discussion among all members of the department. Presentations will include reviews and critiques of recent articles and books within the field and those relevant to it. In addition, original informal discussion papers from faculty and students will be generated for presentation and discussion. Guest speakers and discussants will be encouraged when deemed appropriate.

FMCD 610 Familimetrics. (3) Prerequisites, FMCD 401 and statistics. The primary focus is on the advantages and limitations of family research procedures and the degree of correspondence between these methods. Ways of developing and evaluating adequate research procedures will be emphasized and recent innovations in the field will be considered.

FMCD 615 Needs Assessment in Family and Community Development (3) Exploration and application of needs assessment in family and community programs. A survey of the theoretical and empirical literature on needs, the quality of life, and social indicators is followed by a workshop approach to the problems of conducting a needs assessment, including instrument design, implementation, data analysis, and reporting.

FMCD 625 Advanced Consumer Affairs. (3) An analysis of current consumer behavior found in varous family life styles and of community processes for dealing with consumer problems. Emphasis is given to recent research and theoretical frameworks in the consuemr area.

FMCD 630 Theory and Research in Human Sexuality. (3) Prerequisites: PSYC 100, SOCY 100, and HLTH 477, or consent of instructor. Survey of theory and research in human sexuality and their implications for contemporary family life.

FMCD 660 Program Planning and Evaluation. (1–6) Consideration is given to research program development and/or evaluation of an existing research program in relation to objectives and need. Reporting of research for publication in a journal and periodicals will also be stressed.

FMCD 668 Special Topics in Family Life. (1–6) Individual study or arranged group study.

FMCD 678 Special Topics in Community Development 1–3 Individual study or arranged group study.

FMCD 686 Introduction to Family Counseling. (3) This course gives the fundamental theoretical concepts and clinical procedures that are unique to family and marital therapy. Family and marital therapy are contrasted with individually-oriented psychotherapy in terms of historical development, assumptions and techniques. Various types of clinical techniques for marital and family therapists are presented. Premarital, marital and family, divorce counseling approaches are considered.

FMCD 688 Special Topics in Management-Consumer. (1–3) Individual study or arranged group study.

FMCD 691 Family-Community Consultation. (3) The improvement of family and community environments through the process of consultation. Emphasis on techniques and approaches to consultation including both the role of the consultant and the needs of community agencies and family programs. Field experience with problem-solving methodologies and planning of consultation programs.

FMCD 695 Practicum in Family and Community Services. (3) A field experience which provides one of the following: (1) direct contact with family life styles different from one's own (2) observation and/or (3) experience of a professional role in working with families (consulting, counseling, informal education, leadership training, community action, case work, etc.). Observation and/or experience with services, educational programs or action programs dealing with a particular type of family problem (financial, consumer, help in emergencies, health, housing, homemaker rehabilitation, family relationships and management) will be included.

FMCD 698 Special Topics in General Human Ecology (1–6) Individual study or arranged group study.

FMCD 799 Master's Thesis Research. (1–6)

Food, Nutrition and Institution Administration Program

Professor and Chairman: Prather
Professors: Ahrens, Beaton
Associate Professors: Cox, Williams
Assistant Professors: Axelson, Brady, Moser, Caliendo,
Adjunct Assistant Professors: Michaelis, Reynolds, Rinke, Rosebrough
Adjunct Associate Professors: Kelsay, Szepesi
Adjunct Professors: Bodwell, Reiser, Trout

The Department offers a program leading to a Master of Science degree in each of the following major areas: food, nutrition, and institution administration. The Department participates in an interdepartmental program for Master of Science and Doctor of Philosophy degrees in nutritional science which is described under that title. The area of food includes study in experimental foods as well as cultural and consumer aspects of food. Nutrition includes the science of nutrition as well as the broad area of community and clinical nutrition. Institution administration includes all phases of food service systems.

Please also check the "Food Science" and "Nutritional Sciences" program entries.

Admission and Degree Information

In addition to minimum Graduate School requirements, a satisfactory score on the aptitude portion of the Graduate Record Examination is required. A minimum combination of 1000 with a minimum of 450 on both the verbal and quantitative is required for admission.

Thesis and non-thesis options are available for the Masters of Science degree in food, nutrition or institution administration.

All students are required to take Seminar, Research Methods and a statistics course. Other courses are selected with the guidance of an advisor and/or a committee. Non-thesis option students must prepare a research paper, present an additional seminar and take a written comprehensive examination in addition to an oral examination. An average of three or four semesters is usually required to complete the M.S. thesis option and two or three semesters for the non-thesis option.

Facilities and Special Resources

The Department has special arrangements and cooperative agreements with laboratories at the Nutrition Institute, A.R.S., U.S.D.A., the University Affiliated Program in Child Development at Georgetown University Hospital Clinic, University of Maryland Hospital in Baltimore and Children's Hospital for students in nutrition and foods. There are faculty members who have advanced degrees in the areas of experimental foods and food chemistry, cultural foods, community nutrition, clinical nutrition, human and animal nutrition, and food service systems.

Financial Assistance

There are a limited number of graduate teaching assistantships, traineeships and research assistantships available.

Additional Information

Copies of a Department mimeograph with additional information concerning admission requirements, courses, faculty, facilities, etc. are available from the Department Chairman.

Courses

FOOD 440 Advanced Food Science. (3) Three lectures per week. Prerequisites: FOOD 250 and CHEM 261 or 461. Chemical and physical properties of food as related to consumer use in the home and institutions.

FOOD 445 Advanced Food Science Laboratory. (1) One three-hour laboratory per week. Prerequisite: CHEM 201 and consent of instructor. Chemical deter-

mination of selected components in animal and plant foods.

FOOD 450 Experimental Food Science. (3) One lecture, two laboratories per week. Prerequisite: FOOD 440 or equivalent. Individual and group laboratory experimentation as an introduction to methods of food research.

FOOD 480 Food Additives. (3) Prerequisite: FOOD 440 or equivalent. Effects of intentional and incidental additives on food quality, nutritive value and safety. Current regulatory procedures.

FOOD 490 Special Problems in Foods. (2–3) Prerequisite: FOOD 440 and consent of instructor. Individual selected problems in the area of food science.

FOOD 498 Special Topics. (1–3) Prerequisite: consent of instructor. Selected current aspects of food. Repeatable to a maximum of six credits if the subject matter is substantially different.

FOOD 610 Readings in Food. (3) Prerequisite: FOOD 440 or consent of instructor. A critical survey of the literature of recent developments in food research.

FOOD 620 Nutritional and Quality Evaluation of Food (3) Prerequisite: FOOD 440 or consent of instructor. Effects of production, processing, marketing, storage, and preparation on nutritive value and quality of foods.

FOOD 640 Food Enzymes. (3) First semester, alternate years. Two lectures and one three-hour laboratory. Prerequisite, FOOD 440 or equivalent. The classification and behavior of naturally occurring and added enzymes in food; includes the effects of temperature, pH, radiation, moisture, etc., on enzyme activity.

FOOD 650 Advanced Experimental Food. (3–5) Second semester. Two lectures and three laboratory periods a week. Selected readings of literature in experimental foods. Development of individual problem.

FOOD 660 Research Methods. (3) Prerequisite: A statistics course. A study of appropriate research methodology and theories including experimental design. Each student is required to develop a specimen research proposal.

FOOD 678 Special Topics in Foods. (1–6) Individual or group study in an area of foods.

FOOD 688 Seminar. (1–2) Reports and discussions of current research in foods.

FOOD 799 Master's Thesis Research. (1–6)

NUTR 425 International Nutrition. (2) Two lectures per week. Prerequisite: course in basic nutrition. Nutritional status of world population and local, national and international programs for improvement.

NUTR 430 Nutritional Biochemistry. (3) Prerequisite: CHEM 261 or equivalent. Nutritional biochemistry with special emphasis on the relationship between biochemistry and nutrition.

NUTR 435 History of Nutrition. (2) Two lectures per week. Prerequisite: course in basic nutrition. A study of the development of the knowledge of nutrition and its interrelationship with social and economic developments.

NUTR 450 Advanced Human Nutrition. (3) Prerequisites: consent of department; NUTR 300 and CHEM 261 or concurrent registration in CHEM 462. Two lectures and one two-hour laboratory. A critical study of the physiological and metabolic influences on nutrient utilization, with particular emphasis on current problems in human nutrition.

NUTR 460 Therapeutic Human Nutrition. (3) Two lectures and one laboratory period a week. Prerequisites: NUTR 300, 450. Modifications of the normal adequate diet to meet human nutritional needs in pathological conditions.

NUTR 470 Community Nutrition. (3) Prerequisites: NUTR 300, 450, 460. A study of different types of community nutrition programs, problems and projects.

NUTR 475 Dynamics of Community Nutrition (3) Prerequisite: NUTR 470 or consent of instructor. The practice of community nutrition. Community assessment; nutrition program planning, implementation and evaluation; nutrition education and counseling; grantmanship; and the legislative process.

NUTR 480 Clinical Dietetics I. (2) Pre-or corequisite: NUTR 450. Corequisite: NUTR 460. Open only to students accepted into the coordinated dietetic program. Principles of interviewing and counseling. Application of principles of normal and therapeutic nutrition in medical and surgical care of patients. Thirteen hours of supervised clinical experience per week is required.

NUTR 485 Clinical Dietetics II. (4) Prerequisite: NUTR 480. Open only to students in the coordinated program in dietetics. Continuation of NUTR 480 with emphasis on development of nutritional care plans and patient education. Fourteen hours of clinical experience per week is required. One two hour lecture.

NUTR 490 Special Problems in Nutrition. (2–3) Prerequisites: NUTR 300 and consent of instructor. Individual selected problems in the area of human nutrition.

NUTR 495 Clinical Dietetics III. (4) Prerequisites: NUTR 485. Open only to senior students in the coordinated dietetic program. Clinical practice in dietetics under supervision of a registered dietician, including responsiblity for nutritional support and nutritional care plans for patients, supervision of dietetic personnel and affiliation with community agencies. Two hundred eighty hours of clinical practice per semester.

NUTR 498 Special Topics. (1–3) Prerequisite: consent of instructor. Selected current aspects of nutrition. Repeatable to a maximum of six credits if the subject matter is substantially different.

NUTR 600 Recent Progress in Human Nutrition. (3) Recent developments in the science of nutrition with emphasis on the interpretation of these findings for application in health and disease.

NUTR 610 Readings in Nutrition. (1–3) Reports and discussions of signifant nutritional research and investigation.

NUTR 615 Maternal and Infant Nutrition. (3) prerequisite: NUTR 460 or equivalent, or consent of instructor. Current literature concerning the importance of diet during pregnancy and infancy on the health of the mother and infant. Physiological and biochemical changes during pregnancy and infancy, current issues in infant feeding, such as possible effects of diet during infancy on obesity and degenerative diseases in later life, and current public health programs designed to serve pregnant women and infants.

NUTR 620 Nutrition for Community Services. (3) Application of the principles of nutrition to various community problems of specific groups of the public. Students may select specific problems for independent study.

NUTR 625 Nutritional Needs of the Developmentally Disabled (2) An anlysis of the handicapping conditions resulting from abnormal brain structure, maturation or function and the effects on nutritional status. Assessment techniques, requirements and treatment approaches.

NUTR 630 Nutritional Aspects of Energy Balance. (3) Prerequisite: CHEM 462 or equivalent, or consent of instructor. The prevalence and basic causes of caloric imbalance, along with a wide variety of approaches to weight control.

NUTR 660 Research Methods. (3) Prerequisite: a statistics course. A study of appropriate research methodology and theories including experimental design. Each student is required to develop a specimen research proposal.

NUTR 670 Intermediary Metabolism in Nutrition. (3) Second semester. Prerequisite: CHEM 461, 462 or equivalent. The major routes of carbohydrate, fat, and protein metabolism with particular emphasis on metabolic shifts and their detection and significance in nutrition.

NUTR 678 Special Topics in Nutrition. (1–6) Individual or Group study in an area of nutrition.

NUTR 680 Human Nutritional Status. (3) First semester, alternate years. Methods of appraisal of human nutritional status, to include dietary, biochemical and anthropometric techniques.

NUTR 698 Seminar in Nutrition. (1–3) A study in depth of a selected phase of nutrition.

NUTR 699 Problems in Nutrition. (1–4) Prerequisite: permission of faculty. Experience in a phase of nutrition of interest to the student. Use is made of experimental animals, human studies and extensive, critical studies of research methods, techniques or data of specific projects.

NUTR 799 Master's Thesis Research. (1–6)

IADM 410 School Food Service. (3) Two lectures and one morning a week for field experience in a school food service. Prerequisite: FOOD 200, or 240 and 250, and NUTR 300, or consent of instructor. Study of organization and management, menu planning, food purchasing, preparation, service, and cost control in a school lunch program.

IADM 440 Food Service Personnel Administration. (2) Prerequisite: IADM 300. Principles of personnel administration in food services, emphasis on personnel selection, supervision and training, job evaluation, wage and payroll structure, current labor regulations, and interpersonal relationships and communications.

IADM 450 Food Service Equipment and Planning. (2) Two lectures a week. Prerequisite: consent of instructor. Equipment design selection, maintenance and efficient layout, relation of the physical facility to production and service.

IADM 455 Manpower Planning and Labor Market in the Food Service Industry. (3) Prerequisites: IADM 440 or BMGT 360 or consent of the instructor. The labor market with particular reference to human resource planning and development, productivity of workforce and the progress of minority towards equal employment opportunities. The future needs and implications indicated by the growth and present dimensions of these and other factors.

IADM 460 Administrative Dietetics I. (2) Corequisite: IADM 360. Open only to students accepted into the coordinated dietetic program. Ten hours of supervised clinical experience per week is required. Application of management theory through guided experience in all aspects of hospital dietary services administration.

IADM 470 Administrative Dietetics II. (4) Prerequisite: IADM 360, 440 and 460. Open only to senior students in the coordinated dietetic program. Continuation of IADM 460. Two hundred eighty hours of supervised clinical practice per semester required, including affiliation with a general hospital.

IADM 480 Practicum in Institution Administration. (3) Prerequisite: consent of the department. In-service training and practical experience, totaling at least 120 hours, in an approved food service operation under direct supervision of practicum advisor.

IADM 488 (1) cr Prerequisite: consent of instructor. Problems and controversies in food service industry. Review of non-text literature and research findings pertinent to current problems.

IADM 490 Special Problems in Food Service. (2–3) Prerequisites: senior standing, five hours in IADM courses and consent of instructor. Individual selected problems in the area of food service.

IADM 498 Special Topics. (1–3) Prerequisite: consent of instructor. Selected current aspects of Institution Administration. Repeatable to a maximum of six credits if the subject matter is subtantially different.

IADM 600 Food Service Administration. (3) First or second semester. Principles of organization and management related to a food system. Control of resources through the use of quantitative methods. Administrative decision-making, and personnel policies and practices.

IADM 610 Readings in Food Administration. (3) Reports and discussion of significant research and development in the area of Food Administration.

IADM 630 Computer Application in Food Service. (3) Alternate years. Prerequisite: IADM 600 or equivalent. The use of automatic data processing and programming for the procurement and issuing of food commodities, processing of ingredients, menu selection, and labor allocations.

IADM 640 Sanitation and Safety in Food Service. (3) Alternate years. Prerequisite: MICB 200. Principles and practices of sanitation and safety unique to the production, storage and service of food in quantity: includes current legislation.

IADM 650 Experimental Quantity Food Production. (3) Alternate years. Two lectures and one three-hour laboratory. Prerequisites: IADM 430 and FOOD 450 or equivalents. Application of experimental methods to quantity food production, recipe development and modification: relationship of food quality to production methods.

IADM 660 Research Methods. (3) Prerequisite: a statistics course. A study of appropriate research methodology and theories including experimental de-

sign. Each student is required to develop a research proposal.

IADM 670 Control and Analysis of Costs in Food Service Industries. (3) Prerequisite—consent of the instructor. Principles of controlling and analyzing costs in food service operations. The effects of these principles on day-to-day operations.

IADM 678 Special Topics in Institutional Food. (1–6) Individual or group study in an area of Institutional Food Service.

IADM 688 Seminar. (1) Reports and discussion of current research in institution administration. May be repeated to a maximum of three semester hours of credit.

IADM 799 Master's Thesis Research. (1–6) First and second semesters. Credit in proportion to work done and results accomplished. Investigation in some phases of institution administration which may form the basis of a thesis.

Food Science Program

Professor and Chairman: Mattick (Dairy Science)
Professors: Wheaton (Agricultural Engineering), Bender (Agricultural and Resource Economics), Young (Animal Science), Keeney (Chemistry), Davis and King (Dairy Science), Kramer, Twigg and Wiley (Horticulture), Health and Thomas (Poultry Science)
Associate Professors: Stewart (Agricultural Engineering), Buric (Animal Science), Westhoff (Dairy Science), Solomos (Horticulture)
Assistant Professors: Frey (Agricultural Engineering), Vijay (Dairy Science)
Visiting Lecturers: Bednarczyk, Berry, Cross, Green

The Food Science Program offers the Master of Science and Doctor of Philosophy degrees. The Program is interdepartmental with participation or support from the Departments of Animal Science, Dairy Science, Horticulture, Poultry Science, Agricultural Engineering, Chemistry, and Agricultural and Resource Economics. Programs of study and research are individually planned with the student and an appropriate committee. Areas of study encompass animal, plant, seafood, and fabricated food products. Specialization is available in food microbiology and fermentations, food chemistry and biochemistry, quality assurance, food engineering and product development, nutritional evaluation, food sanitation, packaging, and distribution.

Admission and Degree Information

In addition to minimum Graduate School requirements, the Aptitude Test of the GRE Examinations is required. The Food Science Admissions Committee evaluates and makes recommendations on all applications based on academic and professional experience and letters of recommendations (at least 3 required). When feasible the Committee may conduct a personal interview. In the absence of a bachelor's degree in Food Science or Food Technology a strong background in physical and biological sciences is recommended. Inadequate prerequisites may result in a recommendation to complete a remedial program as a special student, undergraduate status. Program requirements are as follows: 1) Food Science; the equivalent of the following courses: FDSC 412, 413, Principles of Food Processing; FDSC 421, 423 Food Chemistry; FDSC 430, 434 Food Microbiology; FDSC 431, Food Quality Control. 2) Biochemistry—minimum of 3 hours graduate credit. 3) Colloquium (seminar). Attendance each semester and at least 2 presentations for credit during the program of study. 4) Provisional requirements based on admission must be satisfied as soon as practical.

For the M.S. degree, a student must complete the program of study as approved by his committee which will include the minimum requirements. Students entering the Program without a background in Food Science will probably complete about 30 hours of course work to obtain the M.S. degree. For the M.S. with thesis, a research proposal must be submitted to the student's committee for review and approval by the end of the second semester of study. Students who for various reasons or circumstances cannot readily satisfy the thesis research may complete an additional 6 hours of courses at the 600 level in addition to the program requirements above. A scholarly paper on a subject approved by the committee must be prepared and presented at a regular FDSC colloquium. A final comprehensive examination including defense of the scholarly paper will be conducted by the student's committee. Part of this examination will be written. The above programs should be completed within 3 semesters and a summer session.

For admission to the doctoral program, the M.S. degree is not required but is generally recommended. Students completing an M.S. degree in the FDSC Program, UMCP must receive a favorable recommendation from the M.S. degree final examining committee. Students admitted from outside the FDSC Program, UMCP will be examined orally by their committee as a basis for developing a suitable program of study. The student must complete a program of study as approved by the student's committee including minimum requirements of the Graduate School and FDSC Program requirements. There is no required number of hours of course work. Programs are developed on an individual basis. There is no language requirement. A proposal for dissertation research must be presented to the student's committee for review and approval by the end of the third semester of study. A comprehensive oral examination will be conducted by the committee and other interested faculty members after substantial completion of the program of study and usually before the end of the fourth semester. Satisfactory performance in this examination is required before recommendation for admission to candidacy is granted. Each student will assist in teaching at least one course regardless of whether employed as a graduate assistant. The candidate will defend the dissertation before a committee of at least 5 members appointed by the Dean for Graduate Studies. The candidate's advisor is usually chairman of the committee. It is recommended that the candidate prepare initial drafts of intended publications for review before the final examination. This program should be completed in 3 years or less depending on the candidate's previous background.

Facilities and Special Resources

The combined resources of the participating Departments are available for Food Science research. Laboratories, pilot plants, and equipment are located in the Animal Sciences Center, Holzapfel Hall, Turner Laboratory and Shriver Hall. Facilities are available for the experimental processing of fruits, vegetables, poultry, red meat, and dairy products. A seafood processing facility is located off campus. Laboratories are equipped for microbiological, biochemical, biophysical, and engineering research including facilities for laboratory animals. Instrumentation includes gas-liquid chromatographs, atomic absorption spectrophotometers, electron microscope, radioisotope counters, amino acid analyzer, ultracentrifuge, fermenters, and controlled environment incubator. University research farms are available for both plant and animal production studies. Specialized facilities of nearby government and food industry laboratories are regularly made available for graduate student research. The National Agricultural Library is about 3 miles from the campus. The FDSC Program has an exchange agreement with the Food Science Department of the Central University of Venezuela for graduate study and research.

Financial Assistance

Teaching and research assistantships are made available by the participating Departments. Financial support is also available from contracts and grants and by special arrangements with several nearby government laboratories.

Additional Information

A detailed brochure, "Graduate Study in Food Science," is available in the Program Office and can be obtained by contacting: Dr. J.F. Mattick, Coordinator and Chairman, Food Science Program, Animal Sciences Center, University of Maryland. Telephone: 301–454–3928.

Courses

FDSC 412 Principles of Food Processing I. (3) Two lectures and one laboratory per week. A study of the basic methods by which foods are preserved (unit operations). Effect of raw product quality and the various types of processes on yield and quality of the preserved products.

FDSC 413 Principles of Food Processing II. (3) Three lectures per week. A detailed study of food processing with emphasis on line and staff operations, including physical facilities, utilities, pre-and post-processing operations, processing line development and sanitation.

FDSC 421 Food Chemistry. (3) Three lectures per week. Prerequisites: CHEM 203 and 204. The application of basic chemical and physical concepts to the composition and properties of foods. Emphasis on the relationship of processing technology, to the keeping quality, nutritional value, and acceptability of foods.

FDSC 422 Food Product Research and Development. (3) Two lectures, and one laboratory per week. Prerequisites, FDSC 413, CHEM 461, or permission of instructor. A study of the research and development function for improvement of existing products and development of new, economically feasible and marketable food products. Application of chemical-physical characteristics of ingredients to produce optimum quality products, cost reduction, consumer evaluation, equipment and package development.

FDSC 423 Food Chemistry Laboratory. (2) Pre—or corequisite: FDSC 421. Two laboratories per week. Analysis of the major and minor constituents of food using chemical, physical and instrumental methods in concordance with current food industry and regulatory practices. Laboratory exercises coincide lecture subjects in FDSC 421.

FDSC 430 Food Miobiology. (2) cr Two lectures per week. Prerequisite: MICB 200 or equivalent. A study of microorganisms of major importance to the food industry with emphasis on food-borne outbreaks, public health significance, bioprocessing of foods and control of microbial spoilage of foods.

FDSC 431 Food Quality Control. (4) Three lectures and one laboratory per week. Definition and organization of the quality control function in the food industry; preparation of specifications; statistical methods for acceptance sampling, in-plant and processed product inspection. Instrumental and sensory methods for evaluating sensory quality, identity and wholesomeness and their integration into grades and standards of quality.

FDSC 434 Food Miobiology Laboratory. (2) cr Two laboratories per week. Pre—or corequisite: FDSC 430. A study of techniques and procedures used in the microbiological examination of foods.

FDSC 442 Horticultural Products Processing. (3) Two lectures and one laboratory per week. Commercial methods of canning, freezing, dehydrating, fermenting, and chemical preservation of fruit and vegetable crops.

FDSC 451 Dairy Products Processing. (3) Two lectures and one laboratory per week. Method of production of fluid milk, butter, cheese, condensed and evaporated milk and milk products and ice cream.

FDSC 461 Technology of Market Eggs and Poultry. (3) Two lectures and one laboratory per week. A study of the technological factors concerned with the processing, storage, and marketing of eggs and poultry and the factors affecting their quality.

FDSC 471 Meat and Meat Processing. (3) Two lectures and one laboratory a week. Prerequisite, CHEM 461 or permission of instructor. Physical and chemical characteristics of meat and meat products, meat processing, methods of testing and product development.

FDSC 482 Seafood Products Processing. (3) Two lectures and one laboratory a week. Prerequisite, CHEM 461 or permission of instructor. The principal preservation methods for commercial seafood products with particular reference to the invertebrates. Chemical and microbiological aspects of processing are emphasized.

FDSC 621 Systems Analysis in the Food Industry. (3) Construction and solution of models for optimizing feed, product formulations, nutrient-palatability costs. Methods for optimizing processes, inventories, and transportation systems.

FDSC 631 Advanced Food Miobiology. (2) cr One lecture and one laboratory period a week. Prerequisite, FDSC 430 or permission of instructor. An in depth understanding and working knowledge of a selected number of problem areas and contemporary topics in food microbiology.

FDSC 689 Seminar in Food Science. (1–3) A–Lipids; B–Proteins; C–Carbohydrates; D–Organoleptic Properties; E–Fermentation; F–Enzymes and microorganisms; G–Flavor analysis; I–Assays, Studies in depth of selected phases of food science are frequently best arranged by employment if a lecturer from outside the university to teach a specific phase. Flexibility in the credit offered permits adjustment to the nature of the course.

FDSC 698 Colloquium in Food Science. (1) First and second semester. Oral reports on special topics or recently published research in food science and technology. Distinguished scientists are invited as guest lecturers. A maximum of three credits allowed for the M.S.

FDSC 699 Special Problems in Food Science. (1–4) First and second semesters. Prerequisite CHEM 461 or permission of instructor. Credit according to time scheduled and magnitude of problem. An experimental program on a topic other than the student's thesis problem will be conducted. Four credits shall be the maximum allowed toward on advanced degree.

FDSC 799 Master's Thesis Research. (1–6)

FDSC 811 Advances in Food Technology. (3) First semester, alternate years. Prerequisite, CHEM 461 or permission of instructor. A systematic review of new products, processes and management practices in the food industry

FDSC 899 Doctoral Dissertation Research. (1–8)

French Language and Literature Program

Professor and Chairman: Therrien
Professors: MacBain
Associate Professors: Demaitre, Fink, Hall, Meijer, Russell, Tarica
Assistant Professors: Ashby, Black, Campagna, Felaco, Hage

The Department of French and Italian prepares students for the M.A. and Ph.D. degrees in French language and literature. The composition of the Graduate faculty and the variety of course offerings make it possible for students to specialize in any period or movement of French literature or any aspect of the French language, with the consent of their advisers.

Admission and Degree Information

Entry into the M.A. program is open to students having a solid grounding in French language and literature. All applicants, whether graduates of the University of Maryland or not, must take all parts of the G.R.E., including the Advanced Examination in French.

The students' knowledge of French is screened at the beginning of their first semester through a Language Proficiency Examination. In addition to evidence of independent scholarly research in the form of a thesis (thesis option) or a substantial research paper (non-thesis option), successful completion of the M.A. program involves passing a comprehensive examination (a six-hour written examination followed by a one-hour oral examination) in French literature from the Middle Ages to the present. The M.A. program is generally completed in four semesters, or less if Summer Session offerings are utilized.

Entry into the Ph.D. program is open to the most highly qualified and most highly motivated candidates, who can show that individual research is their major interest and who give evidence of strong qualifications to pursue that interest.

All applicants for the Ph.D. program (except M.A. graduates of this Department) must pass a three-part preliminary examination administered at the start of the Fall semester, consisting of an *explication de texte,* an essay and an oral examination, before being fully admitted to the program. They are then required to complete a program of seminars related to their field of interest and to pass five Special Topic examinations and a Foreign Language translation examination before being admitted to candidacy and beginning work on their dissertation.

Facilities and Special Resources

In addition to the University graduate and undergraduate libraries, the Department maintains a reference library. Area research facilities include the Library of Congress and the Folger Library (specializing in 16th and 18th-century literature).

Financial Assistance

Financial support is available in the form of assistantships and fellowships; for information contact the Department of French and Italian.

Additional Information

For complete information concerning the Department's requirements, set forth in the *Guide to Graduate Programs in French,* write to the Department of French and Italian Language and Literature.

Courses

FREN 400 Applied Linguistics. (3) The nature of applied linguistics and its contribution to the effective teaching of foreign languages. Comparative study of English and French, with emphasis upon points of divergence. Analysis, evaluation and construction of related drills.

FREN 401 Introduction to Stylistics. (3) Prerequisite: FREN 302, or course chairman's consent. Comparative stylistic analysis; detailed grammatical analysis; translation.

FREN 404 Oral Practice for Teachers of French. (3) Prerequisites: FREN 311 and FREN 312, or consent of the instructor. Development of fluency in French, stress on correct sentence structure and idiomatic expression. Credit may not be applied toward the French major

FREN 405 Explication De Textes. (3) Oral and written analysis of short literary works, or of excerpts from longer works chosen for their historical, structural, or stylistic interest, with the purpose of training the major to understand literature in depth and to make mature esthetic evaluations of it

FREN 411 Introduction to Medieval Literature. (3) French literature from the ninth through the fifteenth centry. La Chanson Epique, le Roman Courtois, le Lai, la litterature bourgeoise, le Theatre, la poesie lyrique.

FREN 412 Introduction to Medieval Literature. (3) French literature from the ninth through the fifteenth century. La Chanson epique, le Roman courtois, le Lai; la litterature bourgeoise, le theatre, la poesie lyrique.

FREN 421 French Literature of the Sixteenth Century. (3) The renaissance in France: Humanism, Rabelais, Calvin, the Pleiade, Montaigne, baroque poetry.

FREN 422 French Literature of the Sixteenth Century. (3) The Renaissance in France: Humanism, Rabelais, Calvin, the Pleiade, Montaigne, baroque poetry.

FREN 431 French Literature of the Seventeenth Century. (3) Descartes, Pascal, Corneille, Racine; the remaining great classical writers, with special attention to Moliere.

FREN 432 French Literature of the Seventeenth Century. (3) Descartes, Pascal, Corneille, Racine; the remaining great classical writers, with special attention to Moliere.

FREN 441 French Literature of the Eighteenth Century. (3) Development of philosophical and scientific movement; Montesquieu, Voltaire, Diderot, Rousseau.

FREN 442 French Literature of the Eighteenth Century. (3) Development of philosophical and scientific movement; Montesquieu, Voltaire, Diderot, Rousseau.

FREN 451 French Literature of the Nineteenth Century. (3) Drama and poetry from romanticism to symbolism; the major prose writers of the same period.

FREN 452 French Literature of the Nineteenth Century. (3) Drama and poetry from romanticism to symbolism; the major prose writers of the same period

FREN 461 Studies in Twentieth Century Literature—the Early Years. (3) French poetry, theater and the novel during the age of Proust and Gide.

FREN 462 Studies in Twentieth Century Literature—Mid-Century Writers. (3) Modern French poetry, theater and the novel, with special emphasis on the literature of anxiety and existentialism.

FREN 463 Studies in Twentieth Century Literature—the Contemporary Scene. (3) French writers and literary movements since about 1950, with special emphasis on new forms of the novel and theater.

FREN 471 French Civilization I. (3) French life, customs, culture, traditions (800–1750).

FREN 472 French Civilization II. (3) French life, customs, culture, traditions (1750—present-day France).

FREN 478 Themes and Movements of French Literature in Translation. (3) cr Studies treatments of thematic problems or of literary or historical movements in French literature. Topic to be determined each semester. given in English.

FREN 479 Masterworks of French Literature in Translation. (3) Treats the works of one or more major French writers. Topic to be determined each semester. Given in English.

FREN 488 Pro-Seminar in a Great Literary Figure. (3) Each semester a specialized study will be made of one great French writer chosen from some representative literary period or movement since the middle ages. Repeatable for a maximum of six credits

FREN 489 Pro-Seminar in Themes or Movements of French Literature. (3) Repeatable for a maximum of six credits.

FREN 491 Honors Reading Course, Poetry. (3) H—Honors, Poetry Supervised readings to be taken normally only by students admitted to the honors program.

FREN 492 Honors Reading Course, Novel. (3) H—Honors, Novel Supervised readings to be taken nor-

mally only by students admitted to the honors program.

FREN 493 Honors Reading Course Drama. (3) H—Honors, Drama supervised readings to be taken normally only be students admitted to the honors program.

FREN 494 Honors Independent Study. (3) H—Honors Honors independent study involves guided readings based on an honors reading list and tested by a 6 hour written examination. Honors 494 and 495 are required to fulfill the departmental honors requirement in addition to two out of the following, 491h, 492h, 493h. Open only to students admitted to the departmental honors program.

FREN 495 Honors Thesis Research. (3) H—Honors Honors thesis research involves the writing of a paper under the direction of a professor in this department and an oral examination. Honors 494 and 495 are required to fulfill the departmental honors requirement in addition to two out of the following, 491h, 492h, 493h. Open only to students admitted to the departmental honors program.

FREN 498 Special Topics in French Literature. (3) Repeatable for a maximum of six credits.

FREN 499 Special Topics in French Studies. (3) An aspect oF french studies, the specific topic to be announced each time the course is offered. Repeatable for a maximum of 6 credits.

FREN 600 Problems in Bibliography and Research Methods. (3)

FREN 601 The History of the French Language. (3)

FREN 602 Comparative Romance Linguistics. (3) Also listed as SPAN 612.

FREN 603 Stylistics. (3) Advanced composition, translation, stylistic analysis.

FREN 609 Special Topic in the French Language. (3)

FREN 610 La Chanson de Roland. (3) cr Close reading of the text, study of epic formulae and early medieval literary techniques; reading knowledge of old French desirable.

FREN 619 Special Topic in Medieval French Literature. (3)

FREN 629 Special Topic in Sixteenth Century French Literature. (3)

FREN 630 Corneille. (3)

FREN 631 Moliere. (3)

FREN 632 Racine. (3)

FREN 639 Special Topic in Seventeenth Century French Literature. (3)

FREN 640 Voltaire. (3)

FREN 641 Rousseau. (3)

FREN 642 Diderot. (3)

FREN 649 Special Topic in Eighteenth Century French Literature. (3)

FREN 650 French Poetry in the Nineteenth Century. (3)

FREN 651 French Poetry in the Nineteenth Century. (3)

FREN 652 The French Novel in the Nineteenth Century. (3)

FREN 653 The French Novel in the Nineteenth Century. (3)

FREN 659 Special Topic in Nineteenth Century French Literature. (3)

FREN 660 French Poetry in the Twentieth Century. (3)

FREN 662 The French Novel in the Twentieth Century. (3)

FREN 663 The French Novel in the Twentieth Century. (3)

FREN 664 The French Theatre in the Twentieth Century. (3)

FREN 665 The French Theatre in the Twentieth Century. (3)

FREN 669 Special Topic in Twentieth Century French Literature. (3)

FREN 679 The History of Ideas in France. (3) Analysis of currents of ideas as reflected in different periods and authors of French literature.

FREN 689 Seminar in a Great Literary Figure. (3)

FREN 699 Seminar. (3) Topic to be Determined Each Semester.

FREN 702 Structural French Linguistics. (3) Synchronic description of the phonology, morphology and syntax of modern spoken French: standard French in contrast with other varieties.

FREN 709 College Teaching of French. (1) Introduction to the teaching of French at the college level with particular emphasis on methodology. Seminars in theory, demonstration of different teaching techniques, supervised practice teaching, training in language laboratory procedures, evaluation of instructional materials. Required of all graduate assistants in French. Repeatable to a maximum of two credits.

FREN 798 Master's Independent Study. (1–3) Prerequisite: permission of the department's Director of Graduate studies. Repeatable to a maximum of 3 credits.

FREN 799 Master's Thesis Research. (1–6)

FREN 818 French Literary Criticism. (3) Analysis and evaluation of various trends in literary criticism as a manifestation of the french literary genius. Topic to be determined each semester.

FREN 898 Doctoral Independent Study. (3) Repeatable to a maximum of six credits.

FREN 899 Doctoral Dissertation Research. (1–8)

ITALIAN

ITAL 410 The Italian Renaissance. (3) A study of major trends of thought in Renaissance literature, philosophy, art, and science.

ITAL 498 Special Topics in Italian Literature. (3) Repeatable for a maximum of six credits.

ITAL 499 Special Topics in Italian Studies. (3) An aspect of Italian studies, the specific topic to be announced each time the course is offered. Repeatable for a maximum of 6 credits.

Geography Program

Professor and Chairman: Corey
Professors: Fonaroff, Harper
Associate Professors: Brodsky, Chaves, Groves, Mitchell, Thompson, Wiedel
Assistant Professors: Christian, Cirrincione, Petzold, Sawyer
Lecturers: Kearney, Slocum

The programs for both the Master of Arts and Doctor of Philosophy degrees in the Department of Geography are designed to provide the student with an opportunity for specialization in several areas.

Considering particular advantages inherent in the College Park location the Department has built its graduate program around three major areas of concentration and has assembled in each a group of faculty members with complementary and overlapping interests. The areas are: 1) Physical geography with emphasis on physical systems involving the inter-relationships between landforms, climate, and other environmental elements and their relationship with man's activities including planning and management aspects. The University's meteorology program and Water Resources Research Center and work in agriculture and biology provide support for this program as do various Federal Government environmental programs and the special consortium studying Chesapeake Bay and its resources. 2) A cultural-historical geography area, with particular attention to tropical settlement and resource utilization, health and disease, and various themes of historical geography of the Americas. This specialty draws on the incomparable archival material in the Washington area, in state historical agencies, and in Baltimore. 3) The geography of metropolitan areas and urban systems supported by affiliation with the University's Institute for Urban Studies and regional and local planning agencies. There are particular strengths in social aspects, land use and transportation, and historical geography of urban areas. 4) Cartography.

Individual faculty members have other interests that enable students to work on special programs such as human ecology, environmental problems, medical geography, Latin America, Africa, and cartography. Students planning such programs should contact the Department or appropriate faculty member to determine their feasibility.

Admission and Degree Information

While progress in the graduate program is largely an individual matter, students entering the M.A. program should consider a two-year program normal; those entering the Ph.D. should think of three years as the norm. The Department requires very few particular courses—students at both levels initiate their own programs of coursework and submit a plan of study for approval.

Incoming M.A. students are expected to have an undergraduate degree in the field or in a closely related field, with substantial work in geography. In the latter case, remedial work may be required prior to admission to the degree program. All graduate applicants should submit GRE examination results.

Because of the degree of specialization inherent in Ph.D. training, the Department only considers applicants whose interests coincide with departmental staff competence—in general, the three major areas of geography described above. Prospective students who are unsure whether their interests match those of the Department are encouraged to submit a proposal for consideration.

For admission to the doctoral program, the Department normally requires a grade-point average higher than 3.0 and an M.A. degree from a recognized geography department, or competence in terms of fields of study and level of achievement comparable to the M.A. degree of the Department.

A non M.A.—direct Ph.D. program is possible by petition from the student and upon approval of a faculty committee appointed by the Department Chairman.

M.A. students have the choice of either thesis or non-thesis programs. The non-thesis option involves the preparation of two substantial research papers and is suited to students desiring Breadth of study. All M.A. students take an oral examination defense of a research proposal prior to work on the thesis or papers and a final oral examination based either on the thesis or one of the two research papers.

After completion of formal course-work requirements for the Ph.D., there is a two-part qualifying examination. Part One is a written examination in the student's two major fields of specialization. Part Two is an oral examination evaluating the dissertation proposal. Upon satisfactory completion of the dissertation there is a final oral examination.

Facilities and Special Resources

Departmental research facilities include a cartographic laboratory, a computer graphics and spatial analysis facility, a self-instruction laboratory, and a map and journal collection. A minicomputer graphics system and numerous data terminals are housed in the building in which the Department is located. These new quarters, to which the Department moved in January 1979, include two physical laborator-

ies, cartographic teaching and production laboratories, and a computational laboratory. Several faculty members have particular skills in quantitative methods, computer aided instruction, and other analytical tools; and the Department has its own publication of monographs in an Occasional Papers series.

Additional Information

More detailed information on the M.A. and Ph.D. programs can be obtained from the Department which has available a booklet on the graduate programs.

Courses

GEOG 400 Geography of North America. (3) An examination of the contemporary patterns of American and Candian life from a regional viewpoint. Major topics include: the significance of the physical environment, resource use, the political framework, economic activities, demographic and socio-cultural characteristics, regional identification, and regional problems.

GEOG 402 Geography of Maryland and Adjacent Areas. (3) An analysis of the physical environment, natural resources, and population in relation to agriculture, industry, transport, and trade in the state of Maryland and adjacent areas.

GEOG 406 Historical Geography of North America before 1800. (3) An analysis of the changing geography of the U.S. and Canada from pre-Columbian times to the end of the 18th century. Emphasis on areal variations and changes in the settlements and economies of indian and colonial populations. Areal specialization and the changing patterns of agriculture, industry, trade, and transportation. Population growth, composition and interior expansion. Regionalization.

GEOG 407 Historical Geography of North America after 1800. (3) An analysis of the changing geography of the U.S. and Canada from 1800 to the 1920's. Emphasis on the settlement expansion and socio-economic development of the U.S., and comparisons with Canadian experience. Immigration, economic activities, industrialization, transportation and urbanization.

GEOG 410 Geography of Europe. (3) Agricultural and industrial development of Europe and present-day problems in relation to the physical and cultural setting of the continent and its natural resources.

GEOG 411 Historical Geography of Europe after 1500. (3) An analysis of the changing geography of Europe from the Columbian discoveries until the early 20th Century with particular emphasis on western Europe, the medieval legacy, the impact of overseas expansion, and changing patterns of population, agriculture, industry, trade, and transportation. Attention to the development of the nation-state and to agricultural and industrial revolutions.

GEOG 415 Economic Resources and Development of Africa. (3) The natural resources of Africa in relation to agricultural and mineral production; the various stages of economic development and the potentialities of the future.

GEOG 420 Geography of Asia. (3) Lands, climates, natural resources, and major economic activities in Asia (except Soviet Asia). Outstanding differences between major regions.

GEOG 421 Economic and Political Geography of Eastern Asia. (3) Study of China, Korea, Japan, the Philippines: physical geographic setting, population, economic and political geography. Potentialities of major regions and recent developments.

GEOG 422 Cultural Geography of China and Japan. (3) Survey of geographical distribution and interpretation of cultural patterns of China and Japan. emphasis on basic cultural institutions, outlook on life, unique characteristics of various groups. Trends of cultural change and contemporary problems.

GEOG 423 Economic and Political Geography of South and Southeast Asia. (3) Study of the Indian subcontinent. Farther India, Indonesia; physical geographic setting, population, economic and political geography. Potentialities of various countries and regions and their role in present Asia.

GEOG 431 Economic and Cultural Geography of Caribbean America. (3) An analysis of the physical framework, broad economic and historical trends, cultural patterns, and regional diversification of Mexico, Central America, the West Indies.

GEOG 432 Economic and Cultural Geography of South America. (3) A survey of natural environment and resources, economic development and cultural deversity of the South American republics, with emphasis upon problems and prospects of the countries.

GEOG 434 Historical Geography of the Hispanic World. (3) An examination of the social, economic, political and cultural geography of the countries of the Iberian peninsula and Latin America in the past with concentration on specific time periods of special significance in the development of these countries.

GEOG 435 Geography of the Soviet Union. (3) The natural environment and its regional diversity. Geographical factors in the expansion of the Russian state. The geography of agricultural and industrial production in relation to available resources, transportation problems, and diversity of population.

GEOG 437 Introduction to Regional Methods. (3) Inquiry into the evolution of regional methodology with specific reference to geographic problems. Critical analysis and evaluation of past and contemporary theories and a thorough examination of alternate regional methodologies. Application of quantitative and qualitative techniques of regional analysis and synthesis to traditional and modern regional geography emphasizing principles of regionalization.

GEOG 440 Process Geomorphology. (3) Study of the major processes involved in the development of landforms, especially weathering, wasting, and fluvial erosion. Evaluation of models of slope and landscape evolution.

GEOG 441 Geomorphological Environment. (3) Prerequisite: GEOG 440. An examination of environments, coastal, glacial, lithologic, etc., which lead to the spatial differentiation of landforms.

GEOG 441 Geomorphological Environment. (3)

GEOG 445 Climatology. (3) The geographic aspects of climate with emphasis on energy-moisture budgets, steady-state and non-steady-state climatology, and climatic variations at both macro and micro-scales.

GEOG 446 Applied Climatology. (3) Prerequisite: GEOG 445 or consent of instructor. An in-depth analysis of the components of the earth's radiation balance and energy budgets: radiation, soil heat flux, and the evaporation process. Measurement and estimation techniques. Practical applications of microclimatological theory and techniques.

GEOG 447 The Physical Environment of Urban Areas (3) Prerequisite: GEOG 201 or consent of instructor. An analysis of the constraints imposed upon urban land use by such environmental factors as geology, geomorphology and hydrology. The effects of urban land use upon climatology, soils, earth processes, water movement and vegetation will be investigated.

GEOG 450 Cultural Geography. (3) Prerequisite: GEOG 201, 202, or consent of instructor. An analysis of the impact of man through his ideas and technology on the evolution of geographic landscapes. Major themes in the relationships between cultures and environments.

GEOG 451 Political Geography. (3) Geographical factors in national power and international relations; an analysis of the role of 'geopolitics' and 'geostrategy,' with special reference to the current world scene.

GEOG 452 Cultural Ecology. (3) Basic issues concerning the natural history of man from the perspective of the geographer. Basic components of selected behavioral and natural systems their evolution and adaptation, and survival strategies.

GEOG 453 Population Geography. (3) Prerequisite: GEOG 202 or consent of instructor. Emphasis on the spatial characteristics of population distribution and growth, migration, fertility and mortality from a global perspective. Basic population-environmental relationships; carrying capacity, density, relationships to national development.

GEOG 455 Urban Geography. (3) Origins of cities, followed by a study of elements of site and location with reference to cities. The patterns and functions of some major world cities will be analyzed Theories of land use differentiation within cities will be appraised.

GEOG 456 The Social Geography of Metropolitan Areas. (3) A socio-spatial approach to man's interaction with his urban environment; the ways people perceive, define, behave in, and structure their cities and metropolitan areas. Spatial patterns of social activities as formed by the distribution and interaction of people and social institutions.

GEOG 457 Historical Geography of Cities. (3) The course is concerned with the urbanization of the United States and Canada prior to 1920. Both the evolution of the urban system across the countries and the spatial distribution of activities within cities will be considered. Special attention is given to the process of industrialization and the concurrent structuring of residential patterns among ethnic groups.

GEOG 459 Proseminar in Urban Geography (3) A problems-oriented course for students with a background in urban geography using a discussion/lecture format. It will focus on a particular sub-field within urban geography each time it is taught taking advantage of the special interests of the instructor.

GEOG 460 Advanced Economic Geography I—Agricultural Resources. (3) Prerequisite: GEOG 201 or 203. The nature of agricultural resources, the major types of agricultural exploitation in the world and the geographic conditions. Main problems of conservation.

GEOG 461 Geographic Aspects of Environmental Quality. (3) Prerequisite: GEOG 202 or consent of instructor. Basic issues of human—environment interactions. Reactions of natural systems to human intervention. Examination of the geographic characteristics of environmental disruptions.

GEOG 462 Water Resources and Water Resource Planning. (3) Prerequisite: GEOG 201 or 203, or permission of instructor. Water as a component of the human environment. A systematic examination of various aspects of water, including problems of domestic and industrial water supply, irrigation, hydroelectric power, fisheries, navigation, flood damage reduction and recreation.

GEOG 463 Geographic Aspects of Pollution. (3) The impact of man on his environment and resultant problems. Examination of the spatial aspects of physical and socio-economic factors in air, water, and land pollution.

GEOG 465 Geography of Transportation. (3) The distribution of transport routes on the earth's surface, patterns of transport routes, the adjustment of transport routes and media to conditions of the natural environment, population centers and their distribution.

GEOG 466 Industrial Localization. (3) Factors and trends in the geographic distribution of the manufacturing industries of the world, analyzed with reference to theories of industrial location.

GEOG 470 History and Theory of Cartography. (3) The development of maps throughout history. Geographical orientation, coordinates and map scales. Map projections, their nature, use and limitations. Principles of representation of features on physical and cultural maps. Modern uses of maps and relationships between characteristics of maps and use types.

GEOG 471 Cartography and Graphics Practicum. (3)

GEOG 472 Problems of Cartographic Representation and Procedure. (3) Two hours lecture and two hours laboratory a week. Study of cartographic compilation methods. Principles and problems of symbolization, classification and representation of map data. Problems of representation of features at different scales and for different purposes. Place-name selection and lettering, stick-up and map composition.

GEOG 473 Problems of Map Evaluation. (3) Two hours lecture and two hours laboratory a week. Schools of topographic concepts and practices. Theoretical and practical means of determining map reliability, map utility, and source materials. Nature, status and problems of topographic mapping in different parts of the world. Non-topographic special use maps. Criteria of usefulness for purposes concerned and of reliability.

GEOG 490 Geographic Concepts and Source Materials. (3) A comprehensive and systematic survey of geographic concepts designed exclusively for teachers. Stress will be placed upon the philosophy of geography in relation to the social and physical sciences, the use of the primary tools of geography, source materials, and the problems of presenting geographic principles.

GEOG 498 Topical Investigations. (1-3) Independent study under individual guidance. Restricted to ad-

vanced undergraduate students with credit for at least 24 hours in geography and to graduate students. Any exception should have the approval of the head of the department.

GEOG 499 Undergraduate Research. (3) Directed regional or systematic study involving several subfields of geography, including cartographic presentation, and usually requiring field work, and leading to an undergraduate thesis.

GEOG 600 Introduction to Graduate Study in Geography. (3) Introduces the student both to research procedures needed in graduate work and to current trends and developments in geographic research. Lectures by various staff members form basis for discussion. Research paper required.

GEOG 601 Field Course. (3)

GEOG 605 Quantitative Spatial Analysis. (3) This course will provide students with a working knowledge of various tools of multivariate analysis in the context of scientific geographic methodology rather than from the statistical theory viewpoint. Emphasis is on the application of statistical tools and a working knowledge of them will be a basis for evaluation of professional literature in the various fields of geography using quantitative techniques. Students should gain a background suitable for using the techniques in research.

GEOG 610 Seminar in Geographic Methodology. (3) The seminar will emphasize an intensive survey of the basic concepts of geography, a critical evaluation of major approaches to the study of geography, and a detailed analysis of the principal methodological problems both theoretical and practical confronting geography today.

GEOG 615 Geomorphology. (3) cr

GEOG 618 Seminar in Geomorphology. (3) Study and discussion of empirical and theoretical research methods applied to geomorphological problems including review of pertinent literature.

GEOG 625 Advanced Climatology. (3) Prerequisite: GEOG 445 or consent of the instructor. Advanced study of elements and controls of the earth's climates. Analysis of the energy and water balances at the earth's surface and their importance and application to life on this planet: radiation, soil heat flux, evaporation and evaportranspiration.

GEOG 626 Applied Climatology. (3) Second semester. Prerequisite: consent of instructor. Study of principles, techniques, and data of micro-climatology, physical and regional climatology relating to such problems and fields as transportation, agriculture, industry, urban planning, human comfort, and regional geographic analysis.

GEOG 628 Seminar in Meteorology and Climatology. (3) Prerequisite: consent of instructor. Selected topics in meteorology and climatology chosen to fit the individual needs of advanced students. Repeatable to a maximum of six credits.

GEOG 638 Seminar in Physical Geography. (3) Prerequisite: consent of instructor. An examination of themes and problems in the field of physical geography. Repeatable to a maximum of six credits.

GEOG 640 Theory and Practice in Cultural Geography. (3) An introductory survey of the basic structure and recent trends in the field of cultural geography. Emphasis on theoretical principles and ar.alytical procedures employed in investigating cultural problems and on literature which has resulted from this research.

GEOG 648 Seminar in Cultural Geography. (3) Prerequisite: GEOG 450 or consent of instructor. An examination of themes and problems in the field of economic geography. Repeatable to a maximum of six credits.

GEOG 655 Theory and Method in Historical Geography. (3) The philosophical and methodological issues associated with historical approaches to human geography. Introduction to the use and interpretation of sources for the study of the North American past. Emphasis on incorporation of time in geographic studies, on the evaluation of traditional approaches to past geographies and on present theoretical, analytical, and empirical procedures employed in historical inquiry.

GEOG 658 Seminar in Historical Geography. (3) An examination of themes and problems in historical geography with reference to selected areas. Prerequisite: consent of instructor.

GEOG 668 Seminar in Economic Geography. (3) Prerequisite: consent of instructor. An examination of themes and problems in the field of economic geography. Repeatable to a maximum of six credits.

GEOG 670 Theory and Method in Urban Geography. (3) Introductory survey of the structure and recent trends in urban geography. Emphasis on concepts in urban geography using a problem solving approach. Urban literature, data sources, urban information systems, and survey research and sampling.

GEOG 678 Seminar in Political Geography. (3) Beginning with a review of contemporary advanced theory, the seminar will turn to problems such as the spatial consequences of political behavior, the political system and the organization of space including perceived space, the organization of political space. Repeatable to a maximum of six semester hours.

GEOG 679 Seminar in Urban Geography. (3) Flexible in format to allow adaptation to particular topic being considered, this seminar is for advanced students in the department's metropolitan areas specialty. Students normally will have had the seminar in economic geography. Possible topics include: metropolitan systems, the impact of migrants and immigrants on the internal structure of the city, the development of black ghettos, the use of particular techniques in urban geographical research.

GEOG 698 Seminar in Cartography. (1-6)

GEOG 718 Seminar in the Geography of Europe and Africa. (3) Prerequisite: GEOG 410, 415 or consent of instructor. Analysis of special problems concerning the resources and development of Europe and Africa. Repeatable to a maximum of six credits.

GEOG 738 Seminar in the Geography of EAst Asia. (3) Analysis of problems concerning the geography of East Asia with emphasis on special research methods and techniques applicable to the problems of this area. Repeatable to a maximum of six credits.

GEOG 748 Seminar in the Geography of Latin America. (3) Prerequisite: GEOG 431, 432 or consent of instructor. an analysis of recent changes and trends in industrial development, exploitation of mineral resources and land utilization. Repeatable to a maximum of six credits.

GEOG 758 Seminar in the Geography of the U.S.S.R. (3) Prerequisite: reading knowledge of Russian and GEOG 435 or consent of instructor. Investigation of special aspects of Soviet geography. Emphasis on the use of Soviet materials. Repeatable to a maximum of six credits.

GEOG 768 Seminar in the Geography of the Near East. (3)

GEOG 788 Selected Topics in Geography. (1-3) Readings and discussion on selected topics in the field of geography. To be taken only with the joint consent of advisor and head of the department of geography.

GEOG 789 Independent Readings. (1-3) Independent reading as arranged between a graduate faculty member and student. Repeatable to a maximum of six credits.

GEOG 790 Internship in Geography. (3) Field experience in the student's specialty in a federal, state, or local agency or private business. A research paper required.

GEOG 798 Independent Study. (1-6) Open only to students in the non-thesis M.A. option.

GEOG 799 Master's Thesis Research. (1-6) cr

GEOG 899 Doctoral Dissertation Research. (1-8)

German Language and Literature Program

Professor and Chairman: Brecht
Professors: Best, Jones, Hering
Associate Professors: Fleck, Beicken, Pfister
Assistant Professors: Bilik, Fletcher, Frederiksen, Mehl, Walker

The Germanic Section of the Department of Germanic and Slavic Languages and Literatures offers programs of study leading to the M.A. and Ph.D. degrees. Specialization includes the following areas: Language Pedagogy and Applied Linguistics; Germanic Philology; Medieval Literature and Culture; Literature of the German Speaking Countries from the Renaissance to the Present.

Admission and Degree Information

In addition to the Graduate School requirements, candidates must have a bachelor's degree with an undergraduate major in German language and literature or the equivalent, and fluency in the written and spoken language. Candidates for the doctorate must have a master's degree in Germanic Studies or in a related discipline, for example: German, Scandinavian Studies, Language Education, Medieval Studies, etc.

Degree requirements for the M.A. (thesis option) are: 24 hours of coursework, the thesis, and a written comprehensive examination. The M.A. (non-thesis option) requires 30 hours of coursework, a mini-thesis with oral defense, and a written comprehensive examination. For both options the comprehensives consist of four two-hour examinations based on the coursework and the M.A. Reading List.

Degree requirements for the Ph.D. are as follows: 1) completion of at least 30 hours of coursework beyond the master's degree, over a period of residency at the University of Maryland of at least one year, and a further 12 hours of dissertation research; 2) a reading skill examination in a language other than English or German, which may be another Germanic language or a language related to the candidate's research; 3) comprehensive written examinations; 4) presentation of the dissertation topic to the Germanic Section graduate faculty before the topic is approved; 5) the dissertation; 6) oral dissertation defense. The doctoral comprehensives consist of six three-hour examinations. The candidate has considerable freedom in choosing the subject to be covered in three of the examinations; the other three being the required fields of philology or applied linguistics, medieval literature, and modern literature. Candidates who opt for all three selected topics in German literature will choose subjects in the following periods: 16th and 17th centuries, 18th century, 19th century, 20th century; in which case the required modern literature examination will require interpretation of a text. Candidates who select topics from other fields such as philology, Scandinavian Studies, medieval studies, etc., will take a general examination in the modern literature required exam.

Facilities and Special Resources

In addition to its course offerings listed below, the Germanic Section of the Department of Germanic and Slavic Languages and Literatures sponsors the German Club, the University of Maryland Chapter of Delta Phi Alpha (the national German language honors society). Distinguished scholars and lecturers, as well as visiting professors, visit the metropolitan area and campus regularly. College Park's closeness to Washington, D.C. facilitates participation in the many cultural functions of the capital with its wealth of German and Scandinavian social groups and national societies.

Financial Assistance

The Germanic Section is able to contribute to the financial support of its graduate students in the form of teaching and non-teaching assistantships as well as several fellowships.

Additional Information

For further information write to: Director of Graduate Studies, Department of Germanic and Slavic Languages and Literature.

Courses

GERM 001 Elementary German for Graduate Students. (3) Intensive elementary course in the German language designed particularly for graduate students who wish to acquire a reading knowledge. This course does not carry credit towards any degree at the university.

GERM 401 Advanced Conversation. (3) Prerequisite: GERM 302 or equivalent. Development of fluency in spoken German. Discussion of contemporary issues.

GERM 403 Advanced Composition (3) Prerequisite: GERM 302 or equivalent. Advanced instruction in writing skills.

GERM 405 Stylistics (3) Prerequisite: GERM 302 or equivalent. Stylistic analysis of oral and written German both literary and non-literary. Intensive study of vocabulary and syntax. Dictionary and composition exercises.

GERM 409 Selected Topics in German Language Study. (3) Prerequisite: GERM 302 and permission of instructor. Repeatable to a maximum of six credits if subject matter is different.

GERM 410 Structure of the German Language. (3) Prerequisite: GERM 302 or equivalent. An introduction to applied linguistics suited to the needs of the advanced student and/or teacher of German. Structural analysis of the phonetics, phonology, morphology, syntax and vocabulary of modern German contrasted with the structure of modern English. Instruction in English.

GERM 415 German/English Translation I (3) An intensive presentation of german grammar limited exclusively to reading skill; graded readings in the arts and sciences. Instruction in English; can not be used to satisfy the Arts and Humanities foreign language reauirement. May not be taken for credit by students who have completed GERM 111–115 and/or GERM 301/302.

GERM 416 German/English Translation II (3) Prerequisites: GERM 302, GERM 415 or equivalent. Written translation of materials from the student's field of study. Discussion of basic problems of German-to-English translation, with examples from students' projects. instruction in English. Cannot be used to satisfy the Arts and Humanities foreign language requirement.

GERM 418 Practicum in german/english translation (3) Prerequisite: GERM 416 or equivalent. Problems of professional translating from german into english; translation of literary and technical texts; the assembling and use of a specialized translator's reference library. May be repeated up to a maximum of six credits.

GERM 420 Methodology, Bibliography and Research Methods. (3) Prerequisite: GERM 115 or equivalent. Principles of literary criticism. Use of German bibliographies, catalogs, and reference works. Techniques of conducting and documenting research. Instruction in German.

GERM 421 Literature of the Middle Ages. (3) Prerequisites: GERM 321 and 322, or permission of instructor. German literature from the 8th through the 15th Centuries. Readings include old high German texts; the German heroic, courtly and popular epic; Minnesang, Meistersang, the late medieval epic: folk literature of the late middle ages. Read in modern German translation.

GERM 422 From the Reformation through the Baroque (3) Prerequisites: GERM 321 and 322, or permission of instructor. Readings of representative authors from the Reformation and the Period of Humanism through the Baroque (CA. 1517—1720). Readings and instruction in German.

GERM 423 From Enlightenment through Storm and Stress (3) Prerequisites: GERM 321 and 322, or permission of instructor. Readings of representative authors from the Enlightenment (1720—1785), the Age of Sentimentalism (1740—1780), and Storm and Stress (1767—1785). Readings and instruction in German.

GERM 424 Classicism (3) Prerequisites: GERM 321 and 322, or permission of instructor. Readings of representative authors from the Age of Classicism (1786—1832). Readings and instruction in German.

GERM 431 Romanticism and Biedermeier (3) Prerequisites: GERM 321 and 322 or permission of instructor. Readings of representative authors from the periods of Romanticism (1798—1835) and Biedermeier (1820—1850). Readings and instruction in German.

GERM 432 Junges Deutschland and Realism (3) Prerequisite: GERM 321 and 322, or permission of instructor. Readings of representative authors from the periods of Junges Deutschland (1830—1850) and Realism (1850—1890). Readings and instruction in German.

GERM 433 Naturalism and Its Counter Currents. (3) Prerequisites: GERM 321 and 322 or permission of instructor. The periods of Naturalism, Impressionism, Neoromanticism and Neoclassicism. Readings include such authors as Anzengruber, Holz, Sudermann, Hauptmann, George, Wedekind, Hofmannsthal, Schnitzler, Rilke, Heinrich Mann, Hesse. Readings and instruction in German.

GERM 438 German Literature in Translation. (3) Different movements, genres, or other special topics will be treated each semester. Repeatable up to a maximum of six credits if subject matter is different. May not be counted in fulfillment of German major requirement for German literature. Readings and instruction in English.

GERM 439 Proseminar in German Literature. (3) Prerequisites: GERM 321 and 322, or permission of instructor. Specialized study of an author, school, genre, or theme. Repeatable to a maximum of six credits if subject matter is different. Readings and instruction in German.

GERM 448 Yiddish Literature in Translation (3) Study of an important Yiddish author, period or theme. readings and instruction in English. Repeatable to a maximum of 6 credits if subject matter is different.

GERM 449 Selected Topics in Yiddish Studies (3) Prerequisite: Permission of instructor. Study of a linguistic, literary or cultural topic in Yiddish studies. Repeatable to a maximum of 6 credits if subject matter is different.

GERM 461 Reading Swedish, Danish and Norwegian I (3) Develops reading facility in three languages in one semester. Texts read include Bergman's Seventh Seal. Tales by H.C. Andersen, excerpts from works by Ibsen and Hamsun, and selected folk literature. No foreign language prerequisite. Not available for credit to students who have taken GERM 164 or GERM 165.

GERM 462 Reading Swedish, Danish and Norwegian II (3) Prerequisite: GERM 461 or permission of instructor. Further development of reading facility.

GERM 463 The Icelandic Family Saga (3) Analysis of the old Norse sage as historiography, literature, and folklore. Readings and instruction in english.

Germ 464 The Fantastic and Historic Saga (3) Mythological/heroic sagas, translation of chivalric materials from the continent, and the histories of the Norwegian kings, the 'Viking Colonies' and the settlement of Iceland contrasted with the classical structure of the family saga, chivalric models, and other national histories by Germanic writers of the middle ages. Readings and instruction in English.

GERM 468 Scandinavian Literature in Translation (3) Study of a major Scandinavian author, genre, period or theme. Readings and instruction in English. Repeatable to a maximum of 6 credits if subject matter is different.

GERM 469 Selected Topics in Scandinavian Studies (3) Prerequisite: Permission of instructor. Study of a linguistic, literary or cultural topic in Scandinavian studies. Repeatable to a maximum of 6 credits if subject matter is different.

GERM 471 Introduction to Indo-European Philology (3) Basic principles of historical language study: terminology of phonetics and morphology, language families, writing systems. Reconstructed Indo-European and surveys of the most important ancient Indo-European languages: Sanskrit, old church Slavonic, Lithuanian, Classic Greek, Latin, Gothic. Instruction in English; no knowledge of German required.

GERM 472 Introduction to Germanic Philology. (3) Prerequisites: GERM 115 and GERM 471, or equivalent. Reconstructed Proto-Germanic and surveys of Gothic, old Norse, old English, old Saxon. The development of high German from the old high German period through middle high German to modern German; a short introduction to modern German dialectology. Instruction in English.

GERM 475 Old Norse. (3) The language of the old Icelandic saga, the Eddas and Skaldic poetry. Reading of texts in the original; historical development of old Norse and its role in the Germanic language family. No knowledge of German or a Scandinavian language required; instruction in English.

GERM 479 Selected Topics in Germanic Philology (3) Prerequisite: Consent of instructor. Selected topics such as comparative Germanic studies, old Norse language or readings in old Norse literature, modern German dialectology. Repeatable to a maximum of six credits if subject matter is different.

GERM 481 The Viking Era (3) An introduction to the lifestyle of northern Europe in the 9th to 11th centuries. Reading and instruction in English.

GERM 482 The Age of Chivalry (3) An introduction to the lifestyle of northern Europe in the 12th to 14th centuries. Reading and instruction in English.

GERM 489 Selected Topics in Germanic Area Studies (3) Selected topics in the cultural and intellectural history of the German and Germanic language areas. In English, repeatable to a maximum of six credits if subject matter is different.

GERM 499 Directed Study (1–3) Prerequisite: Permission of instructor. For advanced students, by permission of department chairman and/or undergraduate advisor. Repeatable to a maximum of 6 credits if subject matter is different.

GERM 611 College Teaching of German. (3) Instruction, demonstration and classroom practice under supervision of modern procedures in the presentation of elementary German courses to college age students.

GERM 621 Medieval Narrative. (3) An introduction to the form and structure of the medieval narrative, treatment of the most important authors and works of the period.

GERM 631 German Lyric Poetry. (3) An exposition of the genre of lync poetry, its metrical and aesthetic background, illustrated by charctenstic examples from the middle ages to the present.

GERM 641 German Novelle. (3) Study of the development of the genre from the 18th century to the present.

GERM 651 German Novel. (3) The theory and structure of the German novel from the baroque to the present.

GERM 661 German Drama. (3) An introduction to the theory and structure of the German drama from the baroque to the present with extensive interpretation of charactenstic works.

GERM 671 Gothic, Old High German, Middle High German I. (3) The first semester of a two-semester practicum in reading gothic, old and middle high German, with emphasis on linguistic analysis.

GERM 672 Gothic, Old High German, Middle High German II. (3) Prerequisite: GERM 671 Continuation of German 671.

GERM 799 Master's Thesis Research. (1–6)

GERM 819 Individual Study. (1–3) Prerequisite: consent of instructor. May be repeated to a maximum of six credits if content differs.

GERM 829 Seminar in German Literature of the Middle Ages. (3) Exhaustive study of one or more representative authors or works of the middle ages. May be repeated to a maximum of nine credits if content differs.

GERM 839 Seminar in 16th and 17th Century Literature. (3) The German literature of the Humanists, the reformation and the baroque is illustrated by study of one or more authors of the 16th or 17th Centuries. May be repeated up to a total of nine credits when content differs.

GERM 849 Seminar in 18th Century Literature. (3) In depth study of one or more authors from the penods Englightenment, Sentimentalism or Storm and Stress or Classicism. May be repeated up to a total of nine credits when content differs.

GERM 859 Seminar in 19th Century Literature. (3) Comprehensive coverage from one or more authors of

Romanticism, Biedermeier, young Germany or Realism. May be repeated for a total of up to nine credits when content differs.

GERM 869 Seminar in 20th Century Literature (3) Concentrated investigation of a literary movement or of one or more authors from the period of Naturalism to the present. May be repeated to a maximum of nine credits if the content is different.

GERM 879 Seminar in Germanic Philology. (3) In depth study of a topic in Germanic or Indoeuropean philogy; comparative Germanic grammar, runology, dialect geography, Eddic or Skaldic poetry, Indoeuropean studies. May be repeated to a maximum of nine credits if content differs.

GERM 889 Seminar in Germanic Area Studies. (3) Comprehensive study of a selected topic in German or Germanic Area studies: history of ideas, cultural history, Germanic literatures other than German, folk literature and folklore. May be repeated to a maximum of nine credits if content differs.

GERM 899 Doctoral Dissertation Research. (1-8)

RUSSIAN

RUSS 001 Elementary Russian for Graduate Students. (3) Intensive elementary course in the Russian language designed particularly for graduate students who wish to acquire reading knowledge. This course does not carry credit towards any degree at the university.

RUSS 401 Advanced Composition. (3)

RUSS 402 Advanced Composition. (3)

RUSS 421 Russian Civilization (in Russian) I. (3) An historical survey of Russian civilization, emphasizing architecture, painting, sculpture, music, ballet and the theater to the beginning of the 19th Century pointing out the inter-relationship of all with literary movements. Taught in Russian.

RUSS 422 Russian Civilization (in Russian) II. (3) An historical survey of Russian Civilization emphasizing architecture, painting, sculpture, music, ballet, and the theater, from the beginning of the 19th Century to the present pointing out the inter-relationships of all with literary movements. Taught in Russian.

RUSS 441 Russian Literature of the Eighteenth Century. (3)

RUSS 451 Russian Literature of the Nineteenth Century. (3)

RUSS 452 Russian Literature of the Nineteenth Century. (3)

RUSS 461 Soviet Russian Literature. (3)

RUSS 462 Soviet Russian Literature. (3)

RUSS 465 Modern Russian Poetry. (3)

RUSS 466 Modern Russian Drama. (3)

RUSS 467 Modern Russian Fiction. (3)

RUSS 468 19th Century Russian Literature in Translation. (3) Development of Russian literary thought in the Russian novel and short prose of the 19th Century. Influence of western literatures and philosophies considered. Repeatable to a maximum of six credits when content differs.

RUSS 470 Applied Linguistics. (3) The nature of applied linguistics and its contributions to the effective teaching of foreign languages. Comparative study of English and Russian, with emphasis upon points of divergence. Analysis, evaluation and construction of related drills.

RUSS 471 Comparative Slavic Linguistics. (3) Comparative Slavic linguistics and, especially, a concept of the place of the Russian language in the world of Slavic culture through the reading of selected texts illustrating common Slavic relationships and dissimilarities.

RUSS 478 Soviet Literature in Translation. (3) Russian literature since 1917, both as a continuation of prerevolutionary traditions and as a reflection of Soviet ideology. Repeatable to a maximum of six credits when content differs.

Government and Politics Program

Professor and Acting Chairman: Phillips
Professors: Anderson, Bobrow, Claude, Hathorn Hsueh, McNelly, Piper, Segal, Young
Associate Professors: Butterworth, Conway, Devine, Elkin, Glass, Glendening, Hardin, Heisler, Koury, Oppenheimer, Pirages, Ranald, Reeves, Stone, Terchek, Uslaner, Wilkenfeld
Assistant Professors: Afford, Christensen, Hunter, Lanning, McCarrick, Nzuwah, Oliver, Peroff, Postbrief, Werbos, Woolpert

The Department of Government and Politics offers programs leading to the degrees of Master of Arts and Doctor of Philosophy. Areas of specialization include American politics, comparative politics, international politics, political behavior, political theory, public administration, and public policy.

Admission and Degree Information

Master's degree candidates may select a thesis or a non-thesis option, both of which require six semester hours of research methods and statistics, six semester hours of political theory, and a comprehensive examination in one field of political science. Both options require a total of 30 semester hours of credit.

The doctoral program is designed for completion within five years and involves seminars, directed research and opportunities for teaching experience. A minimum of at least 36 semester hours of course work at the 600–800 level is required. All students must complete nine hours of research methods and statistics, nine hours of normative, and/or empirical, and/or formal political theory, and a comprehensive examination in two fields of political science. The examination fields are defined by each student in consultation with an advisor and may cut across traditional departmental and disciplinary boundaries.

Financial Assistance

In addition to teaching assistantships, the Department also has a government internship program for students interested in public administration and a limited and variable number of research positions with research grants.

Additional Information

Further information and a manual on graduate study can be secured from the Department's Office of the Director of Graduate Studies.

Courses

GVPT 401 Problems of World Politics. (3) Prerequisite, GVPT 170. A study of governmental problems of international scope, such as causes of war, problems of neutrality, and propaganda. Students are required to report on readings from current literature.

GVPT 402 International Law. (3) Prerequisite, GVPT 170. A study of the basic character, general principles and specific rules of international law, with emphasis on recent and contemporary trends in the field and its relation to other aspects of international affairs.

GVPT 411 Public Personnel Administration. (3) Prerequisite: GVPT 410 or BMGT 360. A survey of public personnel administration, including the development of merit civil service, the personnel agency, classification, recruitment, examination techniques, promotion, service ratings, training, discipline, employee relations, and retirement.

GVPT 412 Public Financial Administration. (3) Prerequisite, GVPT 410 or ECON 450. A survey of governmental financial procedures, including processes of current and capital budgeting, the administration of public borrowing, the techniques of public purchasing, and the machinery of control through pre-audit and post-audit.

GVPT 413 Governmental Organization and Management. (3) Prerequisite, GVPT 410. A study of the theories of organization and management in american government with emphasis on new trends, experiments and reorganizations.

GVPT 414 Administrative Law. (3) Prerequisite, GVPT 170. A study of the discretion exercised by administrative agencies, including analysis of their functions, their powers over persons and property, their procedures, and judical sanctions and controls.

GVPT 417 Comparative Study of Public Administration. (3) Prerequisite, GVPT 280 or 410, or consent of instructor. An introduction to the study of governmental administrative systems viewed from the standpoint of comparative typologies and theoretical schemes useful in cross-national comparisons and empirical studies of the politics of the administrative process in several nations. Both western and nonwestern countries are included.

GVPT 422 Quantitative Political Analysis. (3) Prerequisite, GVPT 220, or consent of instructor. Introduction to quantitative methods of data analysis, including selected statistical methods, block analysis, content analysis, and scale construction.

GVPT 426 Public Opinion. (3) Prerequisite, GVPT 170. An examination of public opinion and its effect on political action, with emphasis on opinion formation and measurement, propaganda and pressure groups.

GVPT 427 Political Sociology. (3) Prerequisite, GVPT 220, or consent of instructor. A study of the societal aspects of political life including selected aspects of the sociology of group formation and group dynamics, political association, community integration and political behavior presented in the context of the societal environments of political systems.

GVPT 429 Problems in Political Behavior (3) Prerequisite, GVPT 170. The problem approach to political behavior with emphasis on theoretical and empirical studies on selected aspects of the political process.

GVPT 431 Introduction to Constitutional Law. (3) Prerequisite, GVPT 170. A systematic inquiry into the general principles of the Americal constitutional system, with special reference to the role of the judiciary in the interpretation and enforcement of the federal constitution.

GVPT 432 Civil Rights and the Constitution. (3) Prerequisite, GVPT 431. A study of civil rights in the American constitutional context, emphasizing freedom of religion, freedom of expression, minority discrimination, and the rights of defendants.

GVPT 433 The Judicial Process. (3) Prerequisite, GVPT 170. An examination of judicial organization in the united states at all levels of government, with some emphasis on legal reasoning, legal research and court procedures.

GVPT 434 Race Relations and Public Law. (3) Prerequisite, GVPT 170. A political and legal examination of the constitutionally protected rights affecting racial minorities and of the constitutional power of the federal courts, congress, and the executive to define, protect and extend these rights.

GVPT 435 Judicial Behavior. (3) A study of judicial decision making at the state and national levels, drawing primarily on the more recent quantitative and behavioral literature.

GVPT 436 The Legal Status of Women. (3) An examination of judicial interpretation and application of common, statutory, and constitutional law as these affect the status of women in American society.

GVPT 441 History of Political Theory—Ancient and Medieval. (3) Prerequisite, GVPT 170. A survey of the principal political theories set forth in the works of writers before Machiavelli.

GVPT 442 History of Political Theory—Modern and Recent. (3) Prerequisite, GVPT 170. A survey of the principal political theories set forth in the works of writers from Machiavelli to J. S. Mill.

GVPT 443 Contemporary Political Theory. (3) Prerequisite, GVPT 441 or 442. A survey of the principal political theories and ideologies from Karl Marx to the present.

GVPT 444 American Political Theory. (3) Prerequisite, GVPT 170. A study of the development and

growth of american political concepts from the colonial period to the present.

GVPT 445 Russian Political Thought. (3) Prerequisite, GVPT 170. A survey and analysis of political ideas in Russia and the Soviet Union from early times to the present.

GVPT 448 Non-Western Political Thought. (3) Political thought originating in Asia, the Middle East, and Africa. This is not a survey of all non-western political thought, but a course to be limited by the professor with each offering. When repeated by a student, consent of instructor is required.

GVPT 450 Comparative Study of Foreign Policy Formation. (3) Prerequisite, GVPT 280 or 300, or consent of instructor. An introduction to the comparative study of foreign policy formation structures and processes followed by a survey of the domestic sources of policy for major states. A conspectus of substantive patterns of foreign policy in analytically salient types of systems is presented. Domestic and global systemic sources of foreign policy are compared.

GVPT 451 Foreign Policy of the U.S.S.R. (3) Prerequisite, GVPT 170. A study of the development of the foreign policy of the Soviet Union, with attention paid to the forces and conditions that make for continuities and changes from tsarist policies.

GVPT 452 Inter-American Relations. (3) Prerequisite, GVPT 170. An analytical and historical study of the Latin-American policies of the United States and of problems in our relations with individual countries, with emphasis on recent developments.

GVPT 453 Recent East Asian Politics. (3) Prerequisite: GVPT 170. The background and interpretation of recent political events in East Asia and their influence on world politics.

GVPT 454 Contemporary African Politics. (3) Prerequisite, GVPT 170. A survey of contemporary development in the international politics of Africa, with special emphasis on the role of an emerging Africa in world affairs.

GVPT 455 Contemporary Middle Eastern Politics. (3) Prerequisite, GVPT 170. A survey of contemporary development in the international politics of the Middle East, with special emphasis on the role of emerging Middle East nations in world affairs.

GVPT 457 American Foreign Relations. (3) Prerequisite, GVPT 170. The principles and machinery of the conduct of American foreign relations, with emphasis on the department of state and the foreign service, and an analysis of the major foreign policies of the United States.

GVPT 460 State and Local Administration. (3) Prerequisite, GVPT 170. A study of the administrative structure, procedures and policies of state and local governments with special emphasis on the state level and on intergovernmental relationships, and with illustrations from Maryland governmental arrangements.

GVPT 461 Metropolitan Administration. (3) Prerequisite, GVPT 170. An examination of administrative problems relating to public services, planning and coordination in a metropolitan environment.

GVPT 462 Urban Politics. (3) Urban political process and institutions considered in the light of changing social and economic conditions.

GVPT 471 Women and Politics (3) Prerequisite: GVPT 170 or permission of instructor. An examination of patterns of political participation among women and of problems of public policy especially relevant to women.

GVPT 473 Legislatures and Legislation. (3) Prerequisite, GVPT 170. A comprehensive study of legislative organization procedure and problems. The course includes opportunities for student contact with congress and with the legislature of Maryland.

GVPT 474 Political Parties. (3) Prerequisite, GVPT 170. A descriptive and analytical examination of American political parties, nominations, elections, and political leadership.

GVPT 475 The Presidency and the Executive Branch. (3) Prerequisite, GVPT 170. An examination of the executive, legislative and party roles of the president in the political process.

GVPT 479 Problems of American Public Policy. (3) Prerequisite, GVPT 170. The background and interpretation of various factors which affect the formation and execution of American public policy.

GVPT 480 Comparative Political Systems. (3) Prerequisite, GVPT 280 and at least one other course in comparative government. A study, along functional lines, of major political institutions, such as legislatures, executives, courts, bureaucracies, public organizations, and political parties.

GVPT 481 Government and Administration of the Soviet Union. (3) Prerequisite, GVPT 170. A study of the adoption of the communist philosophy by the Soviet Union, of its governmental structure and of the administration of government policy in the Soviet Union.

GVPT 482 Government and Politics of Latin America. (3) Prerequisite, GVPT 170. A comparative study of the governmental systems and political processes of the Latin American countries, with special emphasis on Argentina, Brazil, Chile, and Mexico.

GVPT 483 Government and Politics of Asia. (3) Prerequisite, GVPT 280 or 453, or HIST 261, or 262 or HIFN 442, or 445. A comparative study of the political systems of China, Japan, India and other selected Asian countries.

GVPT 484 Government and Politics of Africa. (3) Prerequisite, GVPT 170. A comparative study of the governmental systems and political processes of the African countries, with special emphasis on the problems of nation-building in emergent countries.

GVPT 485 Government and Politics of the Middle East. (3) Prerequisite, GVPT 170. A comparative study of the governmental systems and political processes of the Middle Eastern countries, with special emphasis on the problems of nation-building in emergent countries.

GVPT 486 Comparative Studies in European Politics. (3) Prerequisite, GVPT 280, or consent of instructor. A comparative study or political processes and governmental forms in selected European countries.

GVPT 487 The Government and Politics of South Asia. (3) Political systems and governments of such countries as India, Pakistan, Bangladesh, Ceylon, and Nepal.

GVPT 492 The Comparative Politics of Race Relations. (3) Impact of government and politics on race relations in various parts of the world. The origins, problems, and manifestations of such racial policies as segregation, apartheid, integration, assimilation, partnership, and nonracialism will be analyzed.

GVPT 700 Scope and Method of Political Science. (3) Required of all Ph.D. candidates. A seminar in the methodologies of political science, and their respective applications to different research fields. Interdisciplinary approaches and bibliographical techniques are also reviewed.

GVPT 707 Functional Problems in International Relations—Comparative Systems. (3) A survey from Kautilya to Kaplan of the literature in IR theory with an emphasis on comparative historical systems.

GVPT 708 Seminar in International Relations Theory. (3) An examination of the major approaches, concepts, and theories in the study of world politics with special emphasis on contemporary literature. Repeatable to a maximum of 6 hours.

GVPT 710 Introduction to Graduate Study in Public Administration. (3) An examination of the history, background, and trends of public administration and the basic concepts and the approaches utilized in the organizational process of public bureaucracies. Readings from textual sources will include the following: the study of public administration. The societal and political environment, organization theory and behavior, administrative law, comparative and development administration, policy and systems analysis, program planning and budgeting, manpower resources development, organizational performance and accountability.

GVPT 750 Policy Evaluation (3) An examination of the application of social indicators and accounts, field and laboratory experimentation, formal modeling, and other techniques drawn from the social sciences to problems of public policy selected from various levels of the political system.

GVPT 770 Seminar in American Political Institutions (3) Reports on topics assigned for individual study and reading in the background and development of American government.

GVPT 780 Seminar in the Comparative Study of Politics. (3) An examination of the salient approaches to and conceptual frameworks for the comparative study of politics, followed by the construction of models and typologies of political systems

GVPT 799 Master's Thesis Research. (1–6) cr

GVPT 802 Seminar in International Law. (3) Reports on selected topics assigned for individual study and reading in substantive and procedural international law.

GVPT 803 Seminar in International Political Organization. (3) A study of the forms and functions of various international organizations.

GVPT 808 Selected Topics in Functional Problems in International Relations. (3) An examination of the major substantive issues in contemporary international relations.

GVPT 810 Governmental Organization Theory. (3) A study of recent developments in the area of organizational theory with an emphasis on empirical studies of organizational behavior.

GVPT 812 Seminar in Public Financial Administration. (3) Readings and reports on topics assigned for individual or group study in the field of public financial administration.

GVPT 813 Problems of Public Personnel Administration. (3) Reports on topics assigned for individual study and reading in the field of public personnel administration.

GVPT 814 Developmental Public Administration. (3) Reports, readings and/or field surveys on topics assigned for individual or group study in international, national, regional or local environments.

GVPT 815 Government Administrative Planning and Management. (3) Reports on topics assigned for individual study and reading in administrative planning and management in government

GVPT 816 Studies in Comparative Governmental Administration. (3) An examination of theoretical concepts and empirical findings in the field of comparative administration. Individual readings and research dealing with the civil services of western and non-western nations will be assigned.

GVPT 818 Problems of Public Administration. (3) Reports on topics assigned for individual study and reading in the field of public administration.

GVPT 822 Problems in Quantitative Political Analysis. (3) Prerequisite, three hours of statistics or consent of instructor. Study of selected problems in quantitative political analysis.

GVPT 826 Seminar in Public Opinion. (3) Reports on topics assigned for individual study and reading in the field of public opinion.

GVPT 827 Seminar in Political Sociology. (3) Prerequisites—GVPT 427 or equivalent. Inquires into the conceptual and theoretical foundations of and empirical data in the field of political sociology. Individual readings and research problems will be assigned, dealing with the social contexts of politics and the political aspects of social relationships.

GVPT 828 Selected Problems in Political Behavior. (3) Individual reading and research reports on selected problems in the study of political behavior.

GVPT 840 Analytical Systems and Theory Construction. (3) 54Prerequisite, GVPT 700. Examination of the general theoretical tools available to political scientists and of the problems of theory building. Attention is given to communications theory, decision-making, game theory and other mathematical concepts, personality theory, role theory, structural-functioning analysis, and current behavioral approaches.

GVPT 841 Great Political Thinkers. (3) Prerequisite, GVPT 441. Intensive study of one or more men each semester.

GVPT 842 Man and the State (3) Prerequisite, GVPT 442 Individual reading and reports on such recurring concepts in political theory as liberty, equality, justice, natural law and natural rights, private property, sovereignty, nationalism and the organic state.

GVPT 844 American Political Theory. (3) Prerequisite, GVPT 444. Analytical and historical examination of selected topics in American political thought.

GVPT 845 Marxist Political Theory. (3) Prerequisite, GVPT 443 or consent of instructor. Intensive study and

analysis of the leading ideas of Marx and Engels and their development in the different forms of social democracy and of communism.

GVPT 846 Theories of Democacy. (3) cr Prerequisite, GVPT 442. A survey and analysis of the leading theories of democratic government, with attention to such topics as freedom, equality, representation, dissent, and critics of democracy.

GVPT 847 Seminar in Non-Western Political Theory. (3) Intensive study of selected segments of political theory outside of the western european tradition.

GVPT 848 Current Problems in Political Theory. (3) Prerequisite, GVPT 443. Intensive examination of the development of political theory since the second World War.

GVPT 850 Applied Foreign Policy Analysis. (3) Individual research and reporting on standards of policy performance and analysis with emphasis on data display, information organization, forecasting, and rational resource allocation.

GVPT 857 Seminar in American Foreign Relations (3) Reports on selected topics assigned for individual study and reading in American foreign policy and the conduct of American foreign relations.

GVPT 862 Seminar on Intergovernmental Relations. (3) Reports on topics assigned for individual study and reading in the field of recent intergovernmental relations.

GVPT 868 Problems of State and Local Government. (3) Report of topics assigned for individual study in the field of state local government throughout the United States.

GVPT 869 Seminar in Urban Administration. (3) Selected topics are examined by the team research method with students responsible for planning, field investigation, and report writing.

GVPT 871 Seminar in Public Law (3) Reports on topics for individual study and reading in the fields of constitutional and administrative law.

GVPT 873 Seminar in Legislatures and Legislation. (3) Reports on topics assigned for individual study and reading about the composition and organization of legislatures and about the legislative process.

GVPT 874 Seminar in Political Parties and Politics. (3) Reports on topics assigned for individual study and reading in the fields of political organization and action.

GVPT 876 Seminar in National Security Policy. (3) An examination of the components of United States security policy. Factors, both internal and external, affecting national security will be considered. Individual reporting as assigned.

GVPT 878 Problems in American Government and Politics. (3) An examination of contemporary problems in various fields of government and politics in the United States, with reports on topics assigned for individual study.

GVPT 881 Comparative Governmental Institutions—Soviet Union. (3) An examination of government and politics in the Soviet Union.

GVPT 882 Comparative Governmental Institutions—Latin America. (3) An examination of governments and politics within Latin America.

GVPT 883 Comparative Governmental Institutions—Asia. (3) An examination of governments and politics within Asia.

GVPT 884 Comparative Governmental Institutions—Africa. (3) An examination of governments and politics within Africa.

GVPT 885 Comparative Governmental Institutions—Middle East. (3) An examination of governments and politics within the Middle East.

GVPT 886 Comparative Governmental Institutions—Europe. (3) An examination of governments and politics within Europe.

GVPT 887 Seminar in the Politics of Developing Nations. (3) An examination of the programs of political development in the emerging nations with special references to the newly independent nations of Asia and Africa, and the less developed countries of Latin America. Individual reporting as assigned.

GVPT 888 Selected Topics in Comparative Governmental Institutions. (3) An examination of special topics in comparative politics.

GVPT 889 Selected topics in Area Problems in International Relations (3) Special topics concerning regional problems in the relations of states.

GVPT 898 Readings in Government and Politics. (3) Guided readings and discussions on selected topics in political science.

GVPT 899 Doctoral Dissertation Research. (1–8)

Health Education Program

Professor & Chairman: Burt
Professors: Greenberg, Johnson, Leviton
Associate Professors: Clearwater, Miller, Tifft
Assistant Professors: Allen, Beck, Decker, Feldman, Fertziger, Yarian

The department of Health Education offers a program designed to prepare students to enter health education and related health professions in teaching, research, consulting, and administrative roles. Graduates of the program have placement opportunities in professional education, research, health maintenance, public schools, health care delivery and promotion, and private and governmental consulting settings.

Admission and Degree Information

The Department offers courses of study leading to the degrees of Master of Arts and Doctor of Philosophy. The Masters program offers both thesis and non-thesis options.

The Department offers fully developed tracks of study and some field experience in the areas of Controlling Stress & Tension, Health Behavior, and Safety Education. Advanced degree study is not limited to these areas. Each student, in consultation with the Director of Graduate Studies, designs an individual program of study to meet his/her projected professional needs.

Admission is open to students holding at least a bachelor's degree in areas related to the social, psychological, or biological basis of human health. Entrance requirements include two semesters of human anatomy and physiology, an undergraduate GPA of at least 3.0 and graduate GPA of 3.5, satisfactory G.R.E. scores (quantitave and verbal sections), and letters of recommendation.

Facilities and Special Resources

The student may experience specific application of theory through numerous field studies and departmental service programs in the areas of controlling stress and tension, children's health and development, programs for the aged, weight control, women's health, and safety education. Special departmental facilities include the Psychophysiological Research Laboratory, the Biofeedback Learning Lab, and the Safety Education Center.

The proximity of the National Institutes of Health, the National Library of Medicine, and the Library of Congress render the University of Maryland unusually well suited for graduate work in health education.

Financial Assistance

A limited number of Graduate Teaching and Research Assistantships are available, through the department. University fellowships may also be obtained.

Additional Information

For any additional information and program specifics, write to: Dr. Roger Allen, Director of Research & Graduate Studies.

Courses

HLTH 420 Methods and Materials in Health Education. (3) Prerequisites: HLTH 105 or 140, 310 or consent of instructor. The purpose of this course is to present the interrelationships of curriculum planning, methodology and the selection and use of teaching aids and materials. Special problems associated with health teaching are discussed. Students will become familiar with a variety of resources as well as planning for and presenting demonstration lessons.

HLTH 450 Health Problems of Children and Youth. (3) This course involves a study of the health needs and problems of pupils from the primary grades through high school. Physical, mental and psychosomatic aspects of health are considered in relation to the developmental and school levels. Consideration is given to such topics as diet selection and control; exercise, recreation and rest; emotional upset and its implications; and psychosexual development and problems. The role of the teacher and parent in encouraging optimal health is emphasized.

HLTH 456 Health Problems of the Aging and the Aged. (3) Psychological, physiological, and socioeconomic aspects of aging; nutrition; sexuality; death, dying, and bereavement; self actualization and creativity health needs and crises of the aged.

HLTH 460 Problems in School Health Education in Elementary and Secondary Schools. (2–6) This is a workshop type course designed particularly for inservice teachers to acquaint them with the best methods of providing good health services, healthful environment and health instruction.

HLTH 470 The Health Program in the Elementary School. (3) Prerequisites: HLTH 105 or 140; 310. This course, designed for the elementary school classroom teacher, analyzes biological and sociological factors which determine the health status and needs of the individual elementary school child. The various aspects of the school program are evaluated in terms of their role in health education. The total school health program is surveyed from the standpoint of organization and administration, and health appraisal. Emphasis is placed upon modern methods and current materials in health instruction. (the State Department of Education accepts this course for biological science credit).

HLTH 471 Women's Health. (3) The women's health movement from the perspective of consumerism and feminism. The physician-patient relationship in the gynecological and other medical settings. The gynecological exam, gynecological problems, contraception, abortion, pregnancy, breast and cervical cancer and surgical procedures. Psychological aspects of gynecological concerns.

HLTH 476 Death Education. (3) Examination of the genesis and development of present day death attitudes and behavior by use of a multidisciplinary life cycle approach.

HLTH 477 Fundamentals of Sex Education. (3) This course is concerned with basic information regarding the physical, psychological, social, historical, semantic and comparative cultural aspects of sex. The adjustment needs and problems of children and adults during the course of maturing and aging are studied; and special consideration is given to the sex education program in schools.

HLTH 480 Measurement in Health. (3) Two lectures and two laboratory periods per week. The application of the principles and techniques of educational measurement to the teaching of health and physical education; study of functions and techniques of measurements in the evaluation of student progress toward the objectives of health and physical education, and in the evaluation of the effectiveness of teaching.

HLTH 489 Field Laboratory Projects and Workshop. (1–6) A course designed to meet the needs of persons in the field with respect to workshop and research projects in special areas of knowledge not covered by regularly structured courses. Note: the maximum total number of credits that may be earned toward any degree in physical education, recreation, or health education under PHED, RECR, or HLTH 489 is six.

HLTH 498 Special Topics in Health. (3) Prerequisite: consent of instructor. Topics of special interest in areas not covered by regularly scheduled courses. Repeatable when the subject matter is different.

HLTH 600 Seminar in Health. (1)

HLTH 650 Health Problems in Guidance. (3)

HLTH 651 Seminar on the Health Correlates of the Aging and Aged. (3) Investigates the most recent theoretical formulations, research data, and clinical and therapeutic approaches to improving the health status of the aging. Extensive readings and research project are required.

HLTH 652 Seminar in Death Education. (3) Prerequisite: HLTH 456 or permission of the instructor. The advanced study and investigation of human dying, death, bereavement, suicidal behavior, and their relationship to human health utilizing a multidisciplinary approach.

HLTH 687 Advanced Seminar. (1–3) cr

HLTH 688 Special Problems in Health Education. (1–6)

HLTH 690 Administrative Direction of Health Education. (3)

HLTH 710 Methods and Techniques of Research. (3)

HLTH 720 Scientific Foundations of Health Education. (3)

HLTH 730 Problems in Weight Control. (3) Prerequisite: HLTH 720 or permission of instructor. A study of the causes, health cost, and control of obesity through analysis of lipid-glucose interaction; hunger-satiety theories and mechanisms; psycho-social forces in obesity; body composition, energy output; and disease states related to obesity.

HLTH 740 Modern Theories of Health. (3)

HLTH 750 Stress and Disease. (3) A study of the causative agents of chronic disease with particular emphasis on stress including the physiological response of the human organism to contemporary psycho-social stressors and mechanisms of adaptation and prophylaxis.

HLTH 760 Public Health. (3)

HLTH 799 Master's Thesis Research. (1–6)

HLTH 899 Doctoral Dissertation Research. (1–8)

Hearing and Speech Sciences Program

Professor and Chairman: McCall
Associate Professors: Baker, Dingwall, Hamlet,[1] Yeni-Komshian
Assistant Professors: Bennett, Doudna Fitzgibbons, Roth
Professor Emeritus: Newby
Affiliate Assistant Professor: Cicci, Suter[2]

[1]Joint appointment with School of Dentistry
[2]Joint appointment with School of Medicine

Admission and Degree Information

The Department of Hearing and Speech Sciences offers the M.A. degree with either the thesis or the non-thesis option, and with major emphasis either in speech and language pathology or in audiology. The Master's degree is required for individuals preparing for positions as speech pathologists or audiologists in the schools, in the hospitals or rehabilitation facilities, in hearing and speech centers, or in other clinical settings. Academic course work is combined with supervised clinical practice in the University Speech and Hearing Clinic and in selected outside clinical facilities, so that the graduate will meet the academic requirements for clinical certification by the American Speech and Hearing Association, and for licensing in the State of Maryland. The Master's degree program is accredited by the American Boards of Examiners in Speech Pathology and Audiology.

Applicants for the M.A. degree with an undergraduate major in the hearing and speech sciences or a related field are considered for admission. The M.A. degree program usually requires a full two years of graduate study. The program of study for individuals without a background in the hearing and speech sciences may need to be extended beyond two years. Only full-time students are admitted to the program.

The Department also offers the Ph.D. degree with major emphasis in speech and language pathology, audiology, speech science, or hearing science. Students with a Bachelor's degree or a Master's degree are considered for admission to the doctoral program. Advanced courses in statistics and research design are required of all doctoral candidates. Although no formal minor is required, students are encouraged to take appropriate courses in other departments. The Department does not require proficiency in a foreign language. Course programs for the doctorate are planned by the student and a committee of at least three faculty members. Qualifying interviews are scheduled for each candidate after completion of 12 semester hours in the program. Written and oral comprehensive examinations for admission to candidacy are scheduled at the completion of the formal course program.

In addition to the application materials required by the Graduate School, the Department requires applicants to furnish scores on the aptitude portions of the Graduate Record Examination. Prospective applicants should note that decisions on summer and fall admissions are made in early March, and on spring admissions in early November. Early application is encouraged.

Facilities and Special Resources

The Department's facilities include (1) a seminar room, (2) an integrated audio-visual listening and viewing laboratory, (3) a student teaching laboratory, (4) several modern, well equipped research laboratories and (5) a Hearing and Speech Clinic. The research laboratories support research in the areas of hearing science, perceptual phonetics, acoustical phonetics, physiological phonetics and language. The facilities include four sound rooms, an electrically shielded sound room and an anechoic chamber. The Department's Hearing and Speech Clinic includes three 2-room audiological test suites and twelve diagnostic/therapy rooms equipped for observation. Additional research and clinical facilities are available in the Washington and Baltimore metropolitan areas. The Library of Congress, the National Library of Medicine, and the libraries of the various medical schools in the Washington-Baltimore area supplement the University's library at College Park.

Financial Assistance

The Department is able to provide some financial support in the form of teaching, research or clinical assistantships or traineeships to approximately 40 percent of the graduate students enrolled.

Additional Information

Additional information about the M.A. and Ph.D. programs may be obtained by writing to the Chairman, Department of Hearing and Speech Sciences.

Courses

HESP 400 Speech and Language Development of Children. (3) Analysis of normal processes of speech and language development in children.

HESP 401 Survey of Speech Disorders. (3) Communication disorders in school children. May not be used by majors in hearing and speech sciences to satisfy major or supporting course requirements.

HESP 403 Introduction to Phonetic Science. (3) Prerequisites: HESP 202 and PHYS 102. Phonetic transcription and phonetic principles. Acoustical and perceptual phonetics.

HESP 404 Speech Pathology II. (3) Prerequisite, HESP 302, 305. Etiology and therapeutic management of cleft palate and stuttering

HESP 406 Speech Pathology III. (3) Prerequisite, HESP 302, 305. Etiology and therapeutic management of aphasia and delayed language.

HESP 408 Clinical Practice. (3) Prerequisites: completion of the 21 hours of specified courses for the major, HESP 404 or HESP 406, and permission of the clinical staff. Observation and participation in the speech and hearing clinic. Repeatable to a maximum of six credits, but only three credits may apply toward satisfaction of the major course requirement in hearing and speech sciences.

HESP 410 Principles and Methods in Speech Therapy. (3) Prerequisite, HESP 404 or 406. Comparative methods in the clinical management of speech problems.

HESP 411 Introduction to Audiology. (3) Prerequisites: HESP 202 and PHYS 102. Anatomy and physiology of hearing, introduction to measurement and to rehabilitation of the hearing-handicapped

HESP 412 Rehabilitation of the Hearing Handicapped. (3) Prerequisite: HESP 411. Speech reading, auditory training, and speech training for hard-of-hearing children and adults.

HESP 414 Seminar. (3) Prerequisite, permission of instructor. Individual projects in phonetic science, speech pathology, and audiology.

HESP 421 Phonetics and Phonemics (3) Training in the identification, description and symbolization of of various sounds found in language. Study of scientific techniques for classifying sounds into units which are perceptually relevant for a given language.

HESP 422 Morphology and Syntax (3) A detailed study of language structure. No student may receive credit for both HESP 422 and ENGL 484.

HESP 423 Historical Linguistics (3) Prerequisites: HESP 421 and 422, or equivalent. A study of change in the phonological, grammatical and semantic structures of natural languages; language typology: reconstruction and various allied topics will be treated

HESP 498 Seminar Linguistics (3) Prerequisite: HESP 120. Advanced topics in linguistics. Lectures and discussions by faculty, students and invited outside scholars. Repeatable to a maximum of six credits provided content is different

HESP 499 Independent Study. (1–3) Prerequisite, departmental approval. May be repeated for a maximum of 6 credits.

HESP 604 Acoustical and Perceptual Phonetics. (3) Laboratory techniques in analysis of the acoustical and perceptual characteristics of the speech signal.

HESP 606 Basic Hearing Measurements. (3) Prerequisite: HESP 411 or equivalent. Administration and interpretation of hearing tests by pure tones and by speech; screening and clinical test procedures.

HESP 610 Aphasia. (3) Language problems of adults associated with brain injury.

HESP 612 Stuttering. (3)

HESP 614 Orofacial Anomalies. (3)

HESP 616 Language Disorders of Children. (3)

HESP 620 Articulation Disorders. (3)

HESP 622 Neuromotor Disorders of Speech. (3)

HESP 624 Voice Disorders. (3)

HESP 626 Language Disorders and Learning Disabilities. (3) Language disorders in children: pre-school through adolescence. Effects of oral language disabilities on social and emotional development and learning of academic skills, including implications for assessment and remediation.

HESP 630 Electrophysiological Measurements. (3) Prerequisite: HESP 606 or permission of instructor. Principles and techniques of impedance/admittance and electronystagmographic testing.

HESP 634 Medical Aspects of Speech and Hearing Disorders. (1–3) cr Lectures by physicians on embryological, anatomical, physiological, and neurological bases of speech and hearing disorders.

HESP 638 minor Research Problems. (1–3) Special projects in hearing and speech science. Repeatable for a maximum of 6 credits.

HESP 639 Special Topics in Hearing and Speech Sciences. (1–3) Prerequisite: departmental permission. Intensive coverage of selected topics of current interest. Repeatable to a maximum of 6 credits when contents differs.

HESP 640 Advanced Principles of Hearing and Speech Therapy. (3) Analysis of the clinical process with emphasis on the application of learning theory to treatment of speech disorders.

HESP 648 Clinical Practice in Speech. (1–3) Prerequisite: permission of instructor Supervised training in the application of clinical methods in the diagnosis and treatment of speech disorders. Repeatable for a maximum of 6 credits

HESP 649 Clinical Practice in Audiology. (1–3) Prerequisite, permission of instructor. Supervised training in the application of clinical methods in the diagnosis and treatment of hearing disorders. Repeatable for a maximum of 6 credits.

HESP 700 Hearing-Aid Characteristics and Performance. (3) Electroacoustic characteristics of hearing aids. Methods of hearing-aid evaluation and selection.

HESP 702 Diagnostic Procedures in Speech Pathology. (3) Diagnostic tools and methods in the analysis of various types of speech disorders. practicum required

HESP 704 Physiological Phonetics. (3) Prerequisite, HESP 604. Laboratory techniques in the study of the speech mechanism.

HESP 706 Advanced Clinical Audiology. (3) Prerequisite, HESP 606 or equivalent. Techniques for evaluation of children and adults presenting special diagnostic problems.

HESP 708 Independent Study. (1–6) Prerequisite, permission of instructor. Individual research projects under guidance of a faculty member. Repeatable for a maximum of 6 credits.

HESP 710 Industrial and Environmental Noise Problems. (3) Prerequisite: permission of instructor. Evaluation and control of noise hazards. Effects of noise on man. Medico-legal aspects of noise-induced hearing impairment.

HESP 720 Structure and Function of the Hearing Mechanism. (3) Anatomy and physiology of the peripheral auditory and vestivular systems and pathologies of the peripheral hearing mechanism.

HESP 722 Experimental Audiology. (3) Experimental techniques in the investigation of problems in audiology.

HESP 724 Quantitative Methods in Hearing and Speech Science. (3) Prerequisite, a course in basic statistics. Analysis of current procedures used in quantifying phenomena observed in hearing and speech science.

HESP 728 Advanced Clinical Practice in Speech. (1–8) Prerequisite: HESP 648 and permission of instructor. Clinical internship in selected off-campus facilities. Repeatable to a maximum of 8 credits.

HESP 729 Advanced Clinical Practice in Audiology. (1–8) Prerequisite: HESP 649 and permission of instructor. Clinical internship in selected off-campus facilities. Repeatable to a maximum of 8 credits.

HESP 799 Master's Thesis Research. (1–6)

HESP 804 Instrumental Phonetics. (3) Prerequisites, HESP 604 and 704 or permission of instructor. Instrumental techniques in phonetic science.

HESP 806 Administration of Hearing and Speech Programs. (3) Problems of staffing, budgeting, and operating training and clinical service programs.

HESP 810 Experimental Design in Hearing and Speech Science. (3) Prerequisite: HESP 724 or permission of instructor. Design and evaluation of research projects. Preparation for undertaking the doctoral dissertation.

HESP 820 Bioacoustics. (3) Prerequisite, permission of instructor. Functioning of the hearing mechanism in animals and humans. Laboratory research methods.

HESP 822 Psychoacoustics. (3) Prerequisite, permission of instructor. Study of human response to acoustic stimulation.

HESP 826 Neurophysiology of Hearing. (3) Processing of stimuli by the auditory nervous system.

HESP 848 Seminar in Audiology. (3) Prerequisite, permission of instructor. Repeatable for a maximum of 6 credits.

HESP 858 Seminar in Speech Pathology. (3) Prerequisite, permission of instructor. Repeatable for a maximum of 6 credits.

HESP 868 Seminar in Speech Science. (3) Prerequisite, permission of instructor. Repeatable for a maximum of 6 credits.

HESP 878 Seminar in Language Disorders. (3) Prerequisite, permission of instructor. Repeatable for a maximum of 6 credits.

HESP 899 Doctoral Dissertation Research. (1–8)

History Program

Professor and Chairman: Evans
Professors: Belz, Brush,[1] Callcott, Cockburn, Cole, Duffy, Foust, Gilbert, Gordon, Haber, Harlan, Kent, A. Olson, K. Olson, Rundell, E. Smith, Sparks, Warren, Yaney
Associate Professors: Berlin, Breslow, Farrell,[2] Flack, Folsom, Hoffman Giffin, Greenberg, Grimsted, Kaufman, Holum, Lampe, Majeska, Matossian, Mayo, McCusker, Perinbam, Ridgway, Ruderman, Spiegel, Stowasser, Wright
Assistant Professors: Bradbury, Darden,[3] Eckstein, Harris, Moss, Rozenblit, H. Smith, Sumida, Weismann, Williams, Zilfi

[1]joint appointment with Institute for Physical Sciences and Technology
[2]joint appointment with Secondary Education
[3]joint appointment with Philosophy

The Department of History offers programs leading to the degrees of Master of Arts and Doctor of Philosophy. Areas of specialization include: United States, Ancient, Medieval, Early Modern European, Modern European, British, Russian, Latin American, African*, Middle Eastern*, East Asian, Diplomatic, Science, and Women's History*.

*Asterisked fields at M.A. level only.

Admission and Degree Information

The Master of Arts degree serves both as a firm grounding in a field of history for teaching purposes and as preparation for the expeditious pursuit of the doctorate. In addition to general Graduate School requirements, the aptitude parts of the GRE are required; it should be noted that an undergraduate major in history is not as such required for admission. Thirty credit hours are required for the degree. Fifteen credit hours are normally in the major area of history and nine in a minor area. The minor may be taken within or outside the Department. Departmental requirements for the degree include six hours in M.A. thesis research courses (HIST 799); HIST 600 or HIST 601, which may be used as part of the major or minor; and two 800-level research seminars. A maximum of nine hours of credit may be taken in 400-level courses. A written examination, which is based in large part on a list of books pertaining to the thesis and its area submitted by the student and approved by the advisory committee, may be required upon completion of the coursework, depending upon the area of major specialization. Faculty in the several areas of study determine whether a written examination shall be required for students in their particular area. There will be a final oral examination confined to the thesis and the area in which it lies. Candidates have a nonthesis option under which they take 30 credits, submit two scholarly papers for deposit in the department, and pass a four-hour comprehensive examination in the major area, based on a list of approximately thirty books submitted by the student and approved by the advisory committee.

Admission to the doctoral program will be decided by the student's M.A. examining committee on the basis of the student's record of achievement in coursework, written examination (if required in the student's major area), and thesis and oral defense of the thesis. Completion of a thesis is normally required for M.A. students seeking admission to the doctoral program. Students with M.A. degrees awarded at other institutions will be asked to submit substantial evidence of their written work when they apply for admission to the doctoral program. Within eighteen months after entering the doctoral program every student must pass two written field examinations in his or her major area and one written field examination in a minor area. These examinations will test a broad, intelligent, and informed handling of the major historical problems and literature of that field. With the approval of the Department's Graduate Committee, a student who has earned a Master's degree at another university in an area substantially different from the student's major area of doctoral study may be exempted from the written field examination in the minor area. Every student must take nine credit hours of graduate level courses (400-level or above) in a department or discipline outside the history department.

An oral examination on the student's dissertation prospectus and a bibliography on the dissertation field are required. The dissertation is to be understood as constituting the largest single portion of the doctoral program: it is expected to be a distinct contribution to historical knowledge and/or interpretation.

All doctoral students must show a reading competence in one foreign language; the language examination must be passed before the student takes the written examination in the major field.

Facilities and Special Resources

In addition to the field concentrations described above, the Department of History offers several forms of specialized training. In the field of historical editing the Department has introduced a successful internship course in archival work, in conjunction with the National Archives. Since 1970 the Department has sponsored a journal of history, *The Maryland Historian*, which features scholarly articles and reviews and which provides practical experience for graduate students in the production of a journal. The journal was founded and is managed and produced by graduate students in the Department of History. The Department also sponsors three major editorial projects: the Booker T. Washington Papers; the Samuel Gompers Papers; and the Freedom in Southern Society project. A number of History Department graduate students have gained valuable research and editing experience on these projects, which also receive support from the National Historical Publications and Records Commission. In conjunction with the Department of Philosophy, the Department of History offers a special program of study in the history and philosophy of science. This program, administered by a joint committee comprising members of both departmental faculties, offers undergraduate and graduate courses, sponsors lectures, issues a newsletter, and holds colloquia. Along with several other universities, the Department of History sponsors and participates in the Folger Institute of Renaissance and Eighteenth-Century Studies. The Institute offers seminars for graduate students and faculty, workshops, conferences, colloquia, and

lectures. The Institute awards fellowships to graduate students, and several of these awards have gone to doctoral candidates from the University of Maryland History Department. Still another project supported by the Department of History is the Pompeii excavations under the direction of Professor Wilhelmina Jashemski. This project, which is funded in part by the National Endowment for the Humanities, has furnished subjects for theses and dissertations for graduate students in Ancient History who have worked on it.

Financial Assistance

The Department of History offers financial assistance principally in the form of teaching assistantships to outstanding graduate students. These positions, which vary in number according to the availability of funds and of which there were 46 in the academic year 1979–80, are awarded to advanced students working toward the Ph.D. or M.A. degree. Appointment as a teaching assistant provides students an opportunity to work closely with faculty members in the teaching of undergraduate survey courses in history.

Additional Information

Complete descriptions of programs and requirements may be obtained from the History Department.

Courses

HIST 400 Independent Study. (1–6) Prerequisite: Departmental approval of research project and consent of the department. Available to all students who wish to pursue a specific research topic.

HIST 401 The Scientific Revolution—From Copernicus to Newton. (3) Major events in the history of Physical Science during the 16th and 17th centuries and their relation to philosophy, religion and society in Western Europe. The attack on ancient and medieval scientific theories; the transition from geocentric to heliocentric astronomy; discoveries of Kepler, Galileo and Newton; and the establishment of the 'mechanical philosophy' that dominated early modern science.

HIST 402 The Development of Modern Physical Science—From Newton to Einstein. (3) The history of Physics in the 18th and 19th centuries, including some of its connections with mathematics, technology, chemistry and planetary science. Emphasis on internal technical developments in physical theory, with some discussion of experimental, philosophical and sociological aspects. This is the second part of a three-semester sequence (HIST 401, HIST 402, PHYS 490); each part may be taken independently of the others. For HIST 402 the prerequisites are MATH 110 and PHYS 112 or 117, or equivalent competence in Mathematics and Physics.

HIST 404 History of Modern Biology. (3) The internal development of Biology in the nineteenth and twentieth centuries, including evolution, cell theory, heredity and development, spontaneous generation, and mechanism—vitalism controversies. The philosophical aspects of the development of scientific knowledge and the interaction of Biology with Chemistry and Physics.

HIST 405 Introduction to Archives and Manuscript Repositories I (3) Prerequisite: Departmental approval. History of and basic intellectual problems relating to archives and manuscript repositories; emphasis on problems of selection, access, preservation, inventoring and editing as well as the variety of institutions housing documents. Must be taken concurrently with HIST 406.

HIST 406 Introduction to Archives and Manuscript Repositories II (3) Prerequisite: Departmental approval. Practical experience through placement in cooperating archives or manuscript repositories in the Baltimore/Annapolis/Washington, DC areas. Assignments to specific projects based on intellectual interest of students. Must be taken concurrently with HIST 405.

HIST 407 History of Technology. (3) A survey course designed for junior, senior and graduate students, with a solid base in either Engineering or History; it will cover the time span from Greek antiquity to the first world war. Technology will be studied as a cultural force controlled by laws of its own and operating within a distinctive conceptual framework. The course will concentrate on the changing character of technology in History and on the interactions between technology and other cultural forces such as science, philosophy, art, material culture, and the economy.

HIST 409 Science, Medicine and Technology: Historical Topics. (3) Selected topics in the history of medicine, science and technology. Specific descriptions will be available in the History Department when the course is offered. May be repeated to a maximum of six semester hours.

HIST 410 History of Medicine and Public Health (3) Survey of the history of medicine and public health from primitive times to the present, covering major medical theories, therapeutics, and techniques, the evolution of the medicine man or priest-physician into a professional medical practitioner, and the close relationship between medicine and society.

HIST 412 Readings in Psycho-History. (3) Application of psychological theories to the study of historical personalities and collective behavior; survey of relevant personality theorists, and an evaluation of recent contributions.

HIST 413 History of American Medicine and Public Health (3) History of American medicine and public health ranging from Indian medical concepts and techniques to today's highly sophisticated medicines; the role of the medical profession in society, development of medical education, emergence of public health, and current problems facing medicine.

HIST 414 History of European Ideas I. (3) Review of the basic western intellectual traditions as a heritage from the ancient-world. Selected important currents of thought from the scientific revolution of the 16th and 17th centuries down to the end of the 18th century.

HIST 415 History of European Ideas II. (3) A continuation of HIST 414 emphasizing 19th and 20th century thought.

HIST 416 Modern Jewish Intellectual History I. (3) An introduction to the major ideas and ideologies of the Jewish people from the period of the expulsion from Spain in 1492 until the generation of Moses Mendelssohn and his contemporaries at the end of the eighteenth century. The course will emphasize the major intellectual developments within the Jewish community shaped by its encounter with major cultural developments such as the Renaissance, Reformation and religious scepticism as well as by the constant threats to its collective identity and physical well-being throughout this entire period.

HIST 417 Modern Jewish Intellectual History II. (3) An introduction to the major ideas and ideologies of the Jewish people from the end of the eighteenth century until the present. The course will consider the major intellectual responses to the problem of Jewish identity in the context of the effects of political and social emancipation, nationalism and socialism, secularism and cultural assimilation, as well as political antisemitism and physical extermination upon the Jewish community.

HIST 418 Jews and Judaism: Selected Historical Topics. (3) Repeatable to a maximum of 6 credit hours if topics differ.

HIST 419 Special Topics in History. (3) May be repeated to a maximum of nine hours.

HIST 420 Ancient Greece. (3) Greek history and culture from the Bronze Age to 200 B.C. concentration of the life and institutions of the city-state, poetry and society, the Peloponnesian war, and Alexander the Great.

HIST 421 History of Rome. (3) Roman history from the foundation of the city to the time of Constantine the Great, concentrating on imperialism, the crisis of the republic, Augustus and the organization of monarchy, and city life during the principate. (Students who have received credit for HIFN 410 not admitted.)

HIST 422 Byzantine Empire I. (3) The Eastern Roman Empire from Constantine the Great to the crisis of the ninth century. The development of the Late Roman State into the Medieval Christian Byzantine Empire and the evolution of a distinctive Byzantine culture.

HIST 423 Byzantine Empire II. (3) The Byzantine Empire from the Macedonian Renaissance to the conquest of Constantinople by the Turks in 1453: the Byzantine Empire at its height, the crusades, Byzantium as a minor power, and its contributions to the Renaissance and the cultures of Russia and the Balkans.

HIST 424 History of Russia to 1801. (3)

HIST 425 History of Russia from 1801—1917. (3) A continuation of HIST 424.

HIST 426 The History of Spain and Portugal to 1700. (3) A survey of the ancient, medieval, and early modern history of the Iberian Peninsula with attention to Spanish and Portuguese expansion overseas and the role of Spain in Europe under the Hapsburg Kings.

HIST 427 The History of Spain and Portugal Since 1700. (3) The social, political and cultural development of modern Spain and Portugal, emphasizing the decline of the monarchies, Napoleonic intervention, the loss of the main part of the overseas empires, civil strife, and the rise of strong-man government.

HIST 430 Tudor England. (3) An examination of the political, religious and social forces in English life, 1485–1603, with special emphasis on Tudor government, the English Reformation and the Elizabethan Era.

HIST 431 Stuart England. (3) An examination of the political, religious and social forces in English life, 1603–1714, with special emphasis on Puritanism and the English Revolutions.

HIST 432 Britain in the 18th Century. (3) Developments in Great Britain from the Revolution of 1688 to the end of the Napoleonic Wars.

HIST 433 Modern Britain. (3) A survey of British history from the Age of the French Revolution to World War I with emphasis upon such subjects as Britain's role in the world, the democratization of the state, the problems arising from industrialism and urbanism, and Irish and Imperial problems.

HIST 434 Constitutional History of Great Britain I. (3) Constitutional development in England, with emphasis on the history of the royal prerogative, the growth of the common law, the development of Parliament, and the emergence of systematized government. First semester, to 1485.

HIST 435 Constitutional History of Great Britain II. (3) Constitutional development in England, with emphasis on the history of the royal prerogative, the growth of the common law, the development of parliament, and the emergence of systematized government. second semester, since 1485.

HIST 436 History of the British Empire. (3) An analysis of the development of the British Empire since the American Revolution. Particular emphasis is given to the problem of responsible self-government, the evolution of the British Empire into a commonwealth of nations and the problems of the dependent empire. Recommended prerequisites: HIST 112, 113, 141, or 254.

HIST 437 Modern France from Napoleon to DeGaulle. (3) The changing political and cultural values of French society in response to recurrent crises throughout the 19th and 20th centuries. Students should have had some previous survey of either western civilization or European history.

HIST 440 Germany in the Nineteenth Century, 1815–1914. (3) The development of modern Germany and the rise of national socialism.

HIST 441 Germany in the Twentieth Century, 1914–1945. (3) Germany's aims and policies during World War I, its condition and policies in the inter-war period, the rise of national socialism, and Germany's part in World War II.

HIST 442 The Soviet Union. (3) A history of Soviet Russia and the Soviet Union from 1917 to the present. Stress on the relationship between Marxist theory and practice, and the development of peculiarly socialist institutions and practices.

HIST 443 Modern Balkan History. (3) A political, socio-economic, and cultural history of Yugoslavia, Bulgaria, Romania, Greece, and Albania from the breakdown of Ottoman domination to the present. Emphasis is on movements for national liberation during the nineteenth century and on approaches to modernization in the twentieth century.

HIST 444 Nineteenth Century European Diplomatic History. (3) The development and execution of European diplomacy from the Congress of Vienna to the

outbreak of World War I, concentrating on central and Western Europe.

HIST 445 Twentieth Century European Diplomatic History. (3) The development and execution of European diplomacy from the outbreak of World War I to the conclusion of World War II, concentrating on Central and Western Europe.

HIST 446 European Economic History to 1750. (3) Economic development of Europe from the manorial economy of medieval feudalism through the emergence of capitalist institutions and overseas empires to the advent of the Industrial Revolution.

HIST 447 European Economic History Since 1750. (3) The mainsprings of the Industrial Revolution first in 18th century England and then across the rest of Europe during the 19th and 20th centuries. Emphasis on the English, French, German, Austro-Hungarian and Russian experiences with private capitalism and public policy, including Facism and Communism. Social consequences of industrial development such as urbanization and the rise of labor movements.

HIST 450 Economic History of the United States to 1865. (3) The development of the American economy from Columbus through the Civil War.

HIST 451 Economic History of the United States after 1865. (3) The development of the American economy from the Civil War to the present.

HIST 452 Diplomatic History of the United States to 1898. (3) American foreign relations from the beginning of the American Revolution in 1775 through the Spanish-American War of 1898, including both international developments and domestic influences that contributed to American expansion in world affairs, and analyses of significant individuals active in American diplomacy and foreign policy.

HIST 453 Diplomatic History of the United States since 1898. (3) American foreign relations in the twentieth century during the Age of Imperialism, World War I, the Great Depression, World War II, and the Cold War. A continuation of HIST 452.

HIST 454 Constitutional History of the United States—from Colonial Origins to 1860. (3) The interaction of government, law, and politics in the constitutional system. The nature and purpose of constitutions and constitutionalism: the relationship between the constitution and social forces and influences, the way in which constitutional principles, rules, ideas, and institutions affect events and are in turn affected by events. The origins of American politics and constitutionalism through the constitutional convention of 1787. Major constitutional problems such as the origins of judicial review, democratization of government, slavery in the territories and political system as a whole.

HIST 455 Constitutional History of the United States—Since 1860. (3) American public law and government, with emphasis on the interaction of government, law, and politics. Emphasis on the political—constitutional system as a whole, rather than simply the development of constitutional law by the Supreme Court. Major crises in American government and politics such as Civil War, Reconstruction, the 1890's, the New Deal Era, the civil disorders of the 1960's.

HIST 456 History of Ideas in America to 1865. (3) The ideas, conflicts, myths, and realities that shaped American character and society from the first settlements to the Civil War.

HIST 457 History of Ideas in America since 1865. (3) A continuation of HIST 456.

HIST 458 Selected Topics in Women's History. (3) Selected topics on women in American society including such areas as women and the law, women and politics, the 'feminine mystique' and the 'new feminism.' May be repeated to a maximum of six semester hours. Students previously receiving credit in HIST 408 may not enroll.

HIST 459 Society in America - Historical Topics. (3) A consideration of selected aspects of American society from colonial times to the present. Special emphasis on regionalism, immigration, nativism, minorities, urbanization, and social responses to technological changes. May be repeated to a maximum of six credits if topics are different.

HIST 460 A Cultural and Social History of the American Worker. (3) Examines the free American working class in terms of its composition; its myths and utopias; its social conditions; and its impact on American institutions.

HIST 461 Blacks in American Life: 1865 to Present. (3) The role of the black in America since slavery, with emphasis on twentieth century developments: the migration from farm to city; the growth of the Civil Rights Movement; the race question as a national problem.

HIST 462 The Civil War. (3) A detailed study of historical interpretations; the forces, situations and events that caused the war; the warand its impact.

HIST 463 History of the Old South. (3) The Golden Age of the Chesapeake, the institution of slavery, the frontier south, the antebellum plantation society, the development of regional identity and the experiment in independence.

HIST 464 History of the New South. (3) The experience of defeat, the restructuring of southern society, the impact of industrialization and the modern racial adjustment.

HIST 465 History of the American Frontier—The Trans-Allegheny West. (3) Major historical interpretation of the significance to the period of the Trans-Allegheny West. Assesses the impact of the frontier experience on American history. Equal attention is given to political, economic, social and cultural problems associated with the development of the West. Indian culture, treatment of the Indians, and Indian-White relations are integrated into the course through readings and lectures.

HIST 466 History of the American Frontier—The Trans-Mississippi West. (3) Exploration, settlement and development of the Trans-Mississippi West. Assesses the impact of the frontier experience on American history. Equal attention is given to political, economic, social and cultural problems associated with the development of the West. Indian culture, treatment of the Indians, and Indian-White relations are integrated into the course through readings and lectures.

HIST 467 History of Maryland. (3) Political, social and economic history of Maryland from seventeenth century to the present.

HIST 470 Diplomatic History of Latin America. (3) A survey of the political, economic and cultural relations of the Latin American nations with emphasis on their relations with the United States and the development of the inter-American system.

HIST 471 History of Brazil. (3) The history of Brazil with emphasis on the national period.

HIST 472 History of the Argentine Republic. (3) Concentration upon the recent history of Argentina with emphasis upon the social and economic development of a third world nation.

HIST 473 History of the Spanish Caribbean. (3)

HIST 474 History of Mexico and Central America I. (3) History of Mexico and Central America, beginning with the pre-Spanish Indian cultures and continuing through European contact, conquest, and colonial dominance, down to the beginning of the Mexican War for independence in 1810.

HIST 475 History of Mexico and Central America II. (3) A continuation of HIST 474 with emphasis on the political development of the Mexican nation.

HIST 476 History of Canada. (3) A history of Canada, with special emphasis on the nineteenth century and upon Canadian relations with Great Britain and the United States.

HIST 480 History of Traditional China. (3) China from earliest times to 1644 A.D. Emphasis on the development of traditional Chinese culture, society, and government.

HIST 481 A History of Modern China. (3) Modern China from 1644 to the People's Republic of China. Emphasis on the coming of the West to China and the various stages of the Chinese reaction.

HIST 482 History of Japan to 1800. (3) Traditional Japanese civilization from the age of Shinto mythology and introduction of continental learning down to the rule of military families, the transition to a money economy, and the creation of a townsmen's culture. A survey of political, economic, religious, and cultural history.

HIST 483 History of Japan Since 1800. (3) Japan's renewed contact with the western world and emergence as a modern state, industrial society, and world power, 1800–1931; and Japan's road to war, occupation, and recovery, 1931 to the present.

HIST 485 History of Chinese Communism. (3) An analysis of the various factors in modern Chinese history that led to the victory of the Chinese Communist Party in 1949 and of the subsequent course of events of the People's Republic of China, from ca. 1919 to the present.

HIST 491 History of the Ottoman Empire. (3) Survey of the Ottoman Turkish Empire from 1300 A.D. to its collapse during World War I. Emphasis on the Empire's social and political institutions and its expansion into Europe, the Arab East and North Africa.

HIST 492 The Contemporary Middle East. (3) This course covers the break-up of the Ottoman Empire and the emergence of contemporary states of the area.

HIST 495 Twentieth Century Algeria. (3) A brief survey of the history of Algeria and an in-depth study of twentieth-century events leading up to and including the war of liberation and Algerian independence. Reading knowledge of French desirable.

HIST 496 A History of West Africa. (3) West Africa from approximately 4500 B.C. to the Colonial Era. The development of agricultural and technological achievements, which made it possible for West African civilizations to emerge and endure and the development of the medieval and early modern state systems. The structure of West African societies, the people and their cultural history.

HIST 497 Economic History of West Africa. (3) The economic history of West Africa from neolithic times to the end of the Colonial Era. Reading knowledge of French desirable.

HIST 600 Historiography. (3)

HIST 601 Methods in Historical Research. (3) Techniques of historical research and writing, emphasizing archival research, evaluation of sources, bibliography, and form and style in writing.

HIST 605 The Teaching of History in Institutions of Higher Learning. (1)

HIST 608 Occupational Internship. (1–6) Prerequisite: Permission of department chairman. Individually arranged internship tailored to individual student needs with a cooperating public or private agency in the Metropolitan, Washington/Baltimore area. Repeatable to a maximum of 6 hours.

HIST 609 Readings in the History of Medicine and Modern Science. (3)

HIST 618 Readings in the History of Women. (3)

HIST 619 Special Topics in History. (3)

HIST 628 Readings in Colonial American History. (3)

HIST 629 Readings in the American Revolution and the Formative Period. (3)

HIST 638 Readings in the Middle Period and Civil War. (3)

HIST 639 Readings in Reconstruction and the New Nation. (3)

HIST 648 Readings in Recent American History. (3)

HIST 658 Readings in American Constitutional History. (3)

HIST 659 Readings in American Intellectual History. (3)

HIST 668 Readings in American Social History. (3)

HIST 669 Readings in the Economic History of the United States. (3) An examination of the major issues in the history of the economy of the United States from the 17th century to the present, as these have been discussed by the more important economic historians. Repeatable to a maximum of six hours.

HIST 678 Readings in American Labor History. (3) Social and cultural history of the American working class with special attention to communities based on ethnicity, race, sex, residence and ideology; history of the labor movement; selected comparisons with working-class communities of other countries.

HIST 679 Readings in the History of American Foreign Policy. (3)

HIST 689 Readings in Southern History. (3)

HIST 698 Readings in the History of the American Frontier. (3) The American Frontier Experience 1763–1890. Equal emphasis on the trans-Appalachian and

trans-Missippi West. Repeatable to a maximum of 6 credits.

HIST 718 Readings in Medieval History. (3)

HIST 719 Readings in the History of the Renaissance and Reformation. (3)

HIST 728 Readings in Early Modern European History. (3)

HIST 729 Readings in Modern European History. (3) Reading knowledge of some European language recommended but not required.

HIST 739 Readings in the History of Great Britain and the British Empire Commonwealth. (3)

HIST 748 Readings in Modern French History. (3)

HIST 749 Readings in German History, 1815 to the Present. (3) Reading knowledge of German is encouraged, but not required. May be repeated for a maximum of nine semester hours.

HIST 785 Readings in Eastern European History. (3) Selected topics in the history of the Habsburg Monarchy and the successor states, Poland and the Balkans. Emphasis on the rise of nationalism during the 19th century and the experience with fascism and communism in the20th century.

HIST 759 Readings in Russian History. (3)

HIST 768 Readings in Chinese History. (3)

HIST 769 Readings in Japanese History. (3)

HIST 778 Readings in Latin American History. (3)

HIST 779 Readings in Middle Eastern History. (3)

HIST 788 Readings in European Economic and Labor History. (3) Selected topics in European economic history from 1648 to the second World War. Attention to the mainsprings of industrialization, the economic consequences of war and revolution, and the variety of European labor movements. An introduction to the use of quantitative methods is provided.

HIST 789 Readings in Modern European Intellectual History. (3)

HIST 798 Readings in Jewish History. (3) Readings on selected topics in Jewish history. Emphasis on analysis of primary sources. Reading knowledge of Hebrew recommended. May be repeated to a maximum of 6 credits.

HIST 799 Master's Thesis Research. (1–6)

HIST 808 Seminar in the History of Medicine and Modern Science. (3) Prerequisite: HIST 609 or consent of instructor.

HIST 808 Seminar in the History of Medicine and Modern Science. (3) Prerequisite: HIST 609 or consent of instructor.

HIST 809 Seminar in the History of Women. (3)

HIST 818 Seminar in Historical Editing. (3) An apprenticeship in the editing of documentary sources and scholarly articles for publication. Repeatable to a maximum of six hours.

HIST 820 Seminar in Chinese History. (3)

HIST 821 Seminar in Japanese History. (3)

HIST 828 Seminar in Middle Eastern History. (3)

HIST 829 Seminar in Latin American History. (3)

HIST 838 Seminar in Ancient History. (3) By permission of instructor only. May be repeated to a maximum of six semester hours.

HIST 839 Seminar in Medieval and Early Modern European History. (3)

HIST 840 Seminar in Greek History. (3)

HIST 841 Seminar in Roman History. (3)

HIST 844 Seminar in the History of the Renaissance and Reformation. (3)

HIST 848 Seminar in Modern European History. (3)

HIST 849 Seminar in Russian History. (3)

HIST 850 Seminar in East European History. (3) Research papers on the history of the lands which are now Austria, Hungary, Czechoslovakia, Poland and the Balkan States, from the 18th century to the present.

HIST 851 Seminar in German History. (3) Prerequisite: HIST 749, or consent of instructor. Reading knowledge of German is required. May be repeated to a maximum of six semester hours.

HIST 852 Seminar in Modern French History. (3)

HIST 853 Seminar in Nineteenth Century Europe. (3)

HIST 854 Seminar in 20th Century European History. (3) Seminar in 20th century European history, 1914 to present. Prerequisite: HIST 729, or consent of instructor.

HIST 855 Seminar in Modern European Intellectual History. (3)

HIST 856 Seminar in Modern European Diplomatic History. (3) Prerequisite: Reading ability of either French or German; a course in modern European History. May be repeated for a maximum of nine semester hours.

HIST 857 Seminar in the Social and Cultural History of Europe. (3) Research methods for multi-generational family history, the comparative study of folk cultures, and the study of creative minorities. Includes a general introduction to research in European society and culture.

HIST 858 Seminar in the History of Great Britain and the British Empire-Commonwealth. (3)

HIST 859 Seminar in History of Modern Wars. (3)

HIST 860 Seminar in Tudor and Stuart England. (3)

HIST 861 Seminar in English Law and Government, 1550–1760. (3) Prerequisites: One of the following courses: HIST 430, 431, 432, 435 or consent of instructor. From the accession of Elizabeth I to the death of George II.

HIST 878 Seminar in Colonial American History. (3)

HIST 879 Seminar in the American Revolution and Formative Period. (3)

HIST 880 Seminar in Southern History. (3)

HIST 881 Seminar in American Frontier History. (3) A research-writing seminar dealing with selected topics related to the American Frontier, especially the trans-Appalachian and trans-Missippippi West, 1774 to the 20th century. Repeatable to a maximum of six semester hours.

HIST 882 Seminar in the History of Maryland. (3)

HIST 888 Seminar in the Middle Period and Civil War. (3)

HIST 889 Seminar in Reconstruction and the New Nation. (3)

HIST 890 Seminar in American Intellectual History. (3)

HIST 892 Seminar in American Social History. (3)

HIST 893 Seminar in the Economic History of the United States. (3) A research-writing seminar dealing with selected topics in American economic development from the colonial period to the present. Repeatable to a maximum of six semester hours.

HIST 894 Seminar in American Labor History. (3) Advanced research and writing on selected topics in the history of American workers, their conditions, communities, organizations and ideas.

HIST 895 Seminar in American Constitutional History. (3)

HIST 896 Seminar in the History of American Foreign Policy. (3)

HIST 898 (3) Seminar in Recent American History.

HIST 899 Doctoral Dissertation Research. (1–8)

Concentration in the History and Philosophy of Science

The Committee on the History and Philosophy of Science supervises graduate study leading to the M.A. and Ph.D. degrees in History or Philosophy. Courses are offered in a wide range of subjects in the history and philosophy of science, medicine, and technology, and research facilities are available on the College Park campus and in the Washington area. For advanced research the emphasis is on the history and philosophy of physical and biological science in the 19th and 20th centuries; history of the philosophy of science and scientific ideas; genetics, computer science, geophysics and astronomy; scientific institutions, medicine and public health in the United States. Integration of historical and philosophical interpretations of science is stressed in both teaching and research.

Students should apply for admission to either the History Department or the Philosophy Department, indicating History and Philosophy of Science as the field of specialization. Since people with diverse backgrounds can be successful in this field, there are no rigid requirements for admission; the quality of a student's work in science, history, and philosophy, as demonstrated not only by grades and test scores but also by papers and independent projects, is more important than the numbers of credit hours in these subjects. But prospective students should also be warned that the minimum requirement for doing research in the history and philosophy of science covers substantially more areas than normally expected of Ph.D.'s in any one of the traditional fields of history or philosophy or a science; it includes training in a science equivalent to a B.S. (preferably M.S.) degree, proficiency in both oral and written expression, and ability to read at least one foreign language (preferably both French and German).

The Committee also encourages applications from students who do not intend to obtain a Ph.D. in history and philosophy of science but desire only the M.A. as preparation for careers in science teaching, government service, technical administration, museum work, etc., or who plan to proceed to the Ph.D. in another field.

A few teaching assistantships are available in the History and Philosophy departments for students who have adequate backgrounds in those subjects.

Detailed information may be obtained by writing to: Chairperson, Committee on the History and Philosophy of Science, Skinner Building, University of Maryland.

Studies Leading to the M.A. in History and the M.L.S.

The Department of History and the College of Library and Information Services coordinate two master degree programs to meet the need for multidisciplinary graduate training for archivists, records managers, manuscript curators, rare book librarians, bibliographers, conservation administrators, and those wishing to become subject and research specialists in academic, special, and/or research libraries. Because of the University's proximity to a variety of immensely rich research collections, students are able through internships to gain first-hand experiences that reinforce their classroom instruction.

The aim of the sequence of courses leading to the two degrees is to prepare students to understand the intellectual approach of the research scholar through historical training and to meet those research needs through the information services offered in CLIS. The coordinated curricula provide four main options: 1) Archives and records management; 2) Curatorship of Historical collections; 3) Scholarly editing and publishing; and 4) Reference, research and bibliographic services. The fifty-four hours required for the degrees combine twenty-four hours in each component, plus six elective hours. The M.A.-M.L.S. is a non-thesis plan, but students may choose to write a thesis when such research enhances their program.

Students may apply for admission under the rubric HILS (History-Library Science) either through the Department of History or CLIS. Each has a co-ordinator who serves as an advisor for students. Since many of these courses are offered in sequence, it is important for students to work closely with these advisors. The two degrees are awarded simultaneously, and a student who fails to complete the special requirements for the coordinated degree programs may not receive either degree. If the student subsequently wishes to receive only one degree, he must transfer from HILS either to the graduate program in History (HIST) or to the College of Library and Information Services LBSC and fulfill the normal requirements for the separate M.A. or M.L.S.

A few teaching assistantships are available in the Department of History and the College of Library and Information Services has some fellowship aid for students in this course of directed study. These are awarded on a competitive basis in both components.

Detailed information may be obtained by writing to the HILS Co-ordinator, in either the Department of History or the College of Library and Information Services.

Horticulture Program

Professor and Chairman: Twigg
Professors: Govin, Kramer, Link, Reynolds, Rogers, Scott (emeritus), Shanks, Stark, Thompson, Wiley
Adjunct Professor: Galletta
Associate Professors: Baker, Beste, Bouwkamp, Kundt, McClurg, Pitt, Schales, Solomos
Assistant Professors: Beckjord, Gould, Green, Mityga, Stimart, Swartz, Walsh, Ng.
Visiting Lecturer: Koch.

The Department of Horticulture offers graduate study leading to the Master of Science and Doctor of Philosophy degrees. The Master of Science degree is offered with both thesis and non-thesis options. Candidates place major emphasis in the areas of pomology, olericulture, floriculture, or ornamental horticulture. Within these commodity areas, students may direct their studies and research efforts to mineral nutrition, postharvest physiology, plant breeding, chemical growth regulation, water relations, plant propagation, histochemistry, photoperiodism and environmental control, and other factors affecting production, postharvest handling, and preservation of horticultural crops. The candidate's program may be directed toward a career in research, teaching, extension education, or industry. The research activities required for the thesis or dissertation are normally carried out in conjunction with the research programs of the departmental staff.

Admission and Degree Information

Students entering with a B.S. degree in Horticulture can normally complete all requirements for the M.S. in 2 years on a half-time basis, 4 years for the Ph.D. Full-time students should complete the requirements in a shorter time. Students seeking admission should present undergraduate preparation in horticulture, botany, chemistry, and supporting agricultural disciplines. Those without this background are advised to enroll as undergraduate students to correct these deficiencies. The Graduate Record Examination Aptitude Test is required.

Students entering the doctoral program should have, or plan on completing, a Master of Science degree in Horticulture, although presentation of the M.S. in a related plant science field may be acceptable.

Upon admission, the student selects a faculty advisor and an advisory committee is appointed. It is an early function of the committee to work with the candidate in developing a program of courses and research, to meet the goals and aspirations of the students. The Department requires no foreign language proficiency. A comprehensive, oral examination is given each candidate for the M.S.; candidates for the Ph.D. take an oral qualifying examination covering the dissertation.

Facilities and Special Resources

Modern laboratory and greenhouse facilities are located at the College Park campus. Laboratory instrumentation provides for chromatography, spectrometry, elemental analysis, histology, and other procedures. A system for automatically monitoring respiratory gases and volatiles is available in connection with controlled atmosphere chambers. Controlled-temperature storages and growth chambers provide facilities for postharvest and environmental control studies. Greenhouse and plot areas are available for research with floricultural and ornamental plants. Orchards for research with fruits are located at the Plant Research Farm 7 miles from the campus. Other research studies are conducted cooperatively with fruit growers in the western part of the state. Field research with vegetable crops is carried on at the Vegetable Research Farm, Salisbury, and with ornamental and vegetable crops at Cheston-on-Wye near Grasonville. The Beltsville Research Center of the United States Department of Agriculture is located 3 miles from the campus. Students have the opportunity to attend seminars at the Research Center, to take specialized courses of the USDA graduate school and, in certain cases, to conduct research projects in cooperation with the personnel at the USDA Research Center. In addition to library facilities at the University, the National Agricultural Library at the Research Center is readily available to graduate students of the University.

Financial Assistance

Some graduate students are supported with financial aid. Research and teaching assistantships are offered to students on full admission status, as available. All graduate assistants are expected to assist in the teaching program of the Department, and those in the M.S. program will follow the thesis option.

Courses

HORT 411 Technology of Fruits. (3) Three lectures per week. Prerequisite: HORT 112, or concurrent BOTN 441. A critical analysis of research work and application of the principles of plant physiology, chemistry, and botany to practical problems in commercial production.

HORT 417 Tree and Small Fruit Management. (1) Primarily designed for vocational agriculture teachers and extension agents. Special emphasis will be placed upon new and improved commercial methods of production of the leading tree and small fruit crops. Current problems and their solution will receive special attention.

HORT 422 Technology of Vegetables. (3) Three lectures per week. Prerequisite: HORT 222, prerequisite or concurrent, BOTN 441. A critical analysis of research work and application of principles of plant physiology, chemistry, and botany to practical problems in commercial vegetable production.

HORT 427 Truck Crop Management. (1) Primarily designed for teachers of vocational agriculture and extension agents. Special emphasis will be placed upon new and improved methods of production of the leading truck crops. Current problems and their solutions will receive special attention.

HORT 432 Fundamentals of Greenhouse Crop Production. (3) Three lectures per week. Prerequisite: HORT 231. This course deals with a study of the commercial production and marketing of ornamental plant crops under greenhouse, plastic houses and out-of-door conditions.

HORT 433 Plants for Interior Decoration. (2) Prerequisite: HORT 231 or permission of instructor. A study of the selection, production and use of plants for interior decoration and their installation and maintenance under interior conditions.

HORT 451 Technology of Ornamentals. (3) Three lectures per week. Prerequisite: or concurrent BOTN 441. A study of the physiological processes of the plant as related to the growth, flowering and storage of ornamental plants.

HORT 453 Woody Plant Materials. (3) Prerequisite: BOTN 212. A field and laboratory study of trees, shrubs, and vines used in ornamental plantings.

HORT 454 Woody Plant Materials (3) Prerequisite: BOTN 212. A field and laboratory study of trees, shrubs, and vines used in ornamental plantings.

HORT 456 Production and Maintenance of Woody Plants. (3) Two lectures and one laboratory period a week. Prerequisite or corequisite: HORT 271, 454 A study of the production methods and operation of a commercial nursery and the planting and care of woody plants in the landscape.

HORT 457 Ornamental Horticulture. (1) A course designed for teachers of agriculture and extension agents to place special emphasis on problems of the culture and use of ornamental plants.

HORT 471 Systematic Horticulture. (3) Two lectures and one laboratory period a week. A study of the origin, taxonomic relationship and horticultural classification of fruits and vegetables.

HORT 472 Advanced Plant Propagation. (2) Prerequisite: HORT 271. A study of the anatomy, morphology and physiology of the seed and plant as related to macro and micro forms of propagation. A review of research in propagation.

HORT 474 Physiology of Maturation and Storage of Horticultural Crops. (2) Two lectures a week. Prerequisite: BOTN 441. Factors related to maturation and application of scientific principles to handling and storage of horticultural crops.

HORT 489 Special Topics in Horticulture. (1–3) Credit according to time scheduled and organization of course. A lecture and/or laboratory series organized to study in depth a selected phase of Horticulture not covered by existing courses.

HORT 682 Methods of Horticultural Research. (3) Second semester. One lecture and one four-hour laboratory period a week. The application of biochemical and biophysical methods to problems in biological research with emphasis on plant materials.

HORT 689 Special Topics in Horticulture (1–3) First and second semester. Credit according to time scheduled and organization of the course. Organized as a lecture series on a specialized advanced topic.

HORT 699 Special Problems in Horticulture. (1–3) First and second semester. Credit according to time scheduled and organization of the course. Organized as an experimental program other than the student's thesis problem Maximum credit allowed toward an advanced degree shall not exceed four hours of experimental work.

HORT 781 Edaphic Factors and Horticultural Plants. (3) First semester, alternate years. Prerequisite: BOTN 441. A critical study of scientific literature and current research concerning factors of the soil affecting production of horticultural plants. Selected papers are studied and critically discussed. Attention is given to experimental procedures, results obtained, interpretation of the data, and to evaluation of the contribution.

HORT 782 Chemical Regulation of Growth of Horticultural Plants. (3) Second semester, alternate years. Prerequisite: BOTN 441. A critical review of literature and current research relating to the use of chemicals in controlling growth, and useful in the production, ripening, and handling of horticultural plants and products. Emphasis is placed on experimental procedures and the interpretation of results, current usage in the potentials for future research.

HORT 783 Environmental Factors and Horticultural Plants. (3) First semester, alternate years. Prerequi-

site: BOTN 441. A study of the literature and a discussion of current research concerned with the effects of environmental factors on the growth and fruiting of horticultural plants. Effects of temperature, light, and atmospheric conditions will be considered.

HORT 784 Current Advances in Plant Breeding. (3) Second semester. Alternate years. Three lectures per week. Prerequisite: HORT 274 or permission of instructor. Studies of the genetic and cytogenetic basis of plant breeding, systems of pollination control and their application, mutation breeding, methods of breeding for resistance to plant diseases and environmental pollutants.

HORT 798 Advanced Seminar. (1) Three credit hours maximum allowed toward the M.S. degree or six credit hours maximum toward the Ph.D. degree.

HORT 799 Master's Thesis Research. (1–6)

HORT 899 Doctoral Dissertation Research. (1–8)

Human Development Education Program (Institute for Child Study)

Professor and Chairman: Morgan
Professors: Chapin, Dittmann, Eliot, Goering, Hardy, Perkins
Professors Emeriti: Bowie, Kurtz, Thompson
Associate Professors: Bennett, Flatter, Gardner, Hatfield, Huebner, Koopman, Marcus, Matteson, Milhollan, Rogolsky, Svoboda, Tyler
Assistant Professors: Ames, Bruner, Colletta, Green, Hunt, Robertson-Tchabo

The interdisciplinary programs of the Institute for Child Study attempt to collect, interpret, and synthesize the findings of the human sciences that are concerned with human growth, development, and learning, and to communicate this synthesis to persons who need such understandings as a basis for their practice and planning.

Admission and Degree Information

The Institute for Child Study offers graduate programs leading to Master of Education, Master of Arts with thesis, Doctor of Philosophy, and Doctor of Education degrees, and Advanced Graduate Specialist Certificate (a planned program of 30 graduate hours beyond the Master's degree). In addition to the general requirements of the Graduate School and the College of Education, the Program requires scores on the Miller's Analogies Test competitive with other applicants for admission to master's and doctoral programs, and the possession of a master's degree prior to admission to the doctoral programs. The research oriented M.A. and Ph.D. degree programs in human development are designed to develop student competencies in the theoretical areas of biological, psychological, and sociocultural processes, and related research methods in human development. The practice oriented M.Ed. and Ed.D. programs are designed to develop student competencies in identifying the implications of scientific knowledge for specific situations through training in program design, management, delivery, and evaluation of human services consistent with current scientific knowledge of human development.

The primary thrust of Institute programs is focused upon educational institutions and services and secondarily with other human services which might also draw upon scientific knowledge of human growth and development. Graduate students in Institute programs include teachers, administrators, counselors, certified therapists and psychologists, health professionals, college teachers of child development, and others engaged in practical fields as well as students with training in the traditional scientific disciplines. A student's program is individually developed through consultation with advisers and appropriate committees to meet the unique needs of the student consistent with the purposes and goals of the Institute for Child Study. Knowledge of foreign languages is generally not required unless a need for foreign languages is indicated in the student's program.

Facilities and Special Resources

The Washington, D.C. area and the University of Maryland are particularly rich in resources for graduate study in human development. The faculty of the Institute is uniquely multi-disciplinary, representing the broad range of the human sciences and related applied fields. The Institute has a special book collection available for use by faculty and students, ongoing in-service field programs in child and youth study, and opportunities for participating in research. Internship experiences are available through cooperation with various agencies and schools in the area. Resources of the College of Education include a Center for Young Children, a Curriculum Materials Center, an Educational Technology Center, a Reading Center, Science Center, and financial and advisory support services for research and evaluation.

Courses

EDHD 400 Introduction to Gerontology. (3) An overview of the processes of aging including physiological, sociological, and psychological aspects as an introduction to the field of Gerontology. Analysis of physiological changes, cultural forces and self processes that have a bearing on life quality in the late years. Examination of community action in response to problems of the elderly. Direct field contact with programs for the elderly.

EDHD 411 Child Growth and Development. (3) Growth and development of the child from conception through the early childhood years, with emphasis on development sequences in physical, psychological and social areas. Implications for understanding and working with young children in the home, school, and other settings.

EDHD 413 Adolescent Development. (3) A study of the interplay of physical, cultural and self forces as they influence behavior, development, learning and adjustment during adolescence. Includes observation and case study. This course cannot be used to meet the psychological foundations requirements for teacher certification.

EDHD 416 Scientific Concepts in Human Development III. (3) Guided reading and observation of pupils throughout the school year. Emphasis on human development concepts relating to impact of family, school, society, and peer group on the student. Collection and analysis of data affecting learning and behavior. For in-service educators. (Not open to persons with credit in EDHD 402, 403.)

EDHD 417 Laboratory in Behavior Analysis III. (3) Prerequisite: EDHD 416. Guided reading and observation of pupils throughout the school year. Emphasis on analysis of intrinsic aspects of learning and behavior including cognitive processes, motivation, self-concept, attitudes, and values. For in-service educators. (Not open to persons with credit on EDHD 402, 403.)

EDHD 419 Human Development and Learning in School Settings. (3) Prerequisite: Classroom teaching experience or consent of instructor. Advanced study of human development and learning principles in the continuous study and evaluation of several different phases of the school program over an extended period of time. Repeatable for a maximum of 6 credits if the topics differ.

EDHD 445 Guidance of Young Children. (3) Development of an appreciation and understanding of young children from different home and community backgrounds; study of individual and group problems.

EDHD 460 Educational Psychology. (3) Prerequisities: PSYC 100 or EDUC 300 or equivalent. Offers an examination of research and problems in educational psychology. Includes consideration of measurement and the significance of individual differences, learning, motivation and emotions, transfer of learning, intelligence, attitudes, problem solving, understanding, thinking, and communicating knowledge. The course is intended to provide an overview of educational psychology with an emphasis on learning processes. It may not be substituted for EDUC 300 by regularly matriculated students in the teacher education program.

EDHD 489 Field Experiences in Education. (1–4) Prerequisites: At least six semester hours in Education at the University of Maryland plus such other prerequisites as may be set by the major area in which the experience is to be taken. Planned field experience may be provided for selected students who have had teaching experience and whose application for such field experience has been approved by the Education faculty. Field experience is offered in a given area to both major and nonmajor students. Note: The total number of credits which a student may earn in EDHD 489, 888, and 889 is limited to a maximum of 20 semester hours.

EDHD 498 Special Problems in Education. (1–3) Prerequisite: Consent of instructor. Available only to mature students who have definite plans for individual study of approved problems.

EDHD 499 Workshops, Clinics, and Institutes. (1–6) The maximum number of credits that may be earned under this course symbol toward any degree is six semester hours; the symbol may be used two or more times until six semester hours have been reached. The following type of educational enterprise may be scheduled under this course heading: workshops conducted by the College of Education (or developed cooperatively with other colleges and universities) and not otherwise covered in the present course listing; clinical experiences in pupil-testing centers, reading clinics, speech therapy laboratories, and Special Education centers; institutes developed around specific topics or problems and intended for designated groups such as school superintendents, principals and supervisors.

EDHD 600 Introduction to Human Development and Child Study. (3) An overview of the multidisciplinary, scientific principles which describe human development and behavior and an application of these principles in an analysis of a behavioral record. Techniques of observation, recording, and analysis of human behavior. Emphasis on critiquing and applying research findings.

EDHD 601 Biological Bases of Behavior. (3) EDHD 600 or its equivalent must be taken before EDHD 601 or concurrently. Emphasizes that understanding human life, growth and behavior depends on understanding the ways in which the body is able to capture, control and expend energy. Application throughout is made to human body processes and implications for understanding and working with people.

EDHD 602 Social Bases of Behavior. (3) EDHD 600 or its equivalent must be taken before EDHD 602 or concurrently. Analyzes the socially inherited and transmitted patterns of pressures, expectations and limitations learned by an individual as he grows up. These are considered in relation to the patterns of feeling and behaving which emerge as the result of growing up in one's social group.

EDHD 603 Integrative Bases of Behavior. (3) Prerequisites: EDHD 600 or its equivalent; EDHD 601 and 602. Analyzes the organized and integrated pattern of feeling, thinking and behaving which emerge from the interaction of basic biological drives and potentials with one's unique experience growing up in a social group.

EDHD 610 Physiological Aspects of Aging. (3) Prerequisite: ZOOL 201 or 202 or equivalent, or consent of instructor. Physiological changes with advancing age including cells and tissues; metabolism; homeostasis; and sensorium, with implications with respect to coping with these changes.

EDHD 613 Advanced Laboratory in Behavior Analysis I. (3) First of a three-hour sequence in the study of behavior. Analysis focuses upon the major forces which shape the development and learning of children and youth. Summer session only.

EDHD 615 Advanced Laboratory in Behavior Analysis II. (3) Prerequisite: EDHD 613 or equivalent. Second of a three-course sequence in the behavior analysis of children and youth focusing on self-devel-

opmental and self-adjustive processes. Summer session only.

EDHD 617 Advanced Laboratory in Behavior Analysis III. (3) Prerequisite: EDHD 615 or equivalent. Third of a three-course sequence in the behavioral analysis of children and youth which contrasts the child's concept of self and the world and the world's concept of the child. Summer session only.

EDHD 619 Advanced Scientific Concepts in Human Development. (3) A critical examination of concepts and issues in contemporary culture as these relate to the development and learning of children and youth. Summer session only. Repeatable to a maximum of 6 credits.

EDHD 620 Aging in the Cultural Context. (3) The factors and forces that affect life quality in the late years. Identification of economic, social, and governmental influences in the cultural context that enhance or impede continued growth of the person. Individual projects involving direct field experience.

EDHD 630 Cognitive Processes During Aging. (3) Cognitive functioning of the aged. The roles of cultural, environmental and affectional variables as they contribute to the healthy functioning of cognitive processes. On-site field trips to consolidate an understanding of these interrelationships. Designed for those who desire a fuller understanding of life-span human development and/or are interested in working with the elderly.

EDHD 659 Direct Study of Children. (1) May not be taken concurrently with EDHD 402, 403, or 404. Provides the opportunity to observe and record the behavior of an individual child in a nearby school. These records will be used in conjunction with the advanced courses in Human Development and this course will be used in conjunction with the advanced courses. Teachers active in their jobs while taking advanced courses in Human Development may use records from their own classrooms for this course. A minimum of one year of direct observation of human behavior is required of all human development students at the master's level. This requirement may be satisfied by this course.

EDHD 700 Infant Development. (3) An examination of recent research findings in physical, social, emotional and language development during infancy. A review of prenatal and perinatal factors in relation to their influence on later development.

EDHD 710 Affectional Relationships and Processes in Human Development. (3) EDHD 600 or its equivalent must be taken before or concurrently. Describes the normal development, expression and influence of love in infancy, childhood, adolescence and adulthood. Deals with the influence of parent-child relationship involving normal acceptance, neglect, rejection, inconsistency, and over-protection upon health, learning, emotional behavior and personality adjustment and development.

EDHD 711 Peer-Culture and Group Processes in Human Development. (3) Prerequisite: EDHD 600 or its equivalent must be taken before or concurrently. Analyzes the process of group formation, role-taking and status-winning, describes the emergence of the 'peer-culture' during childhood and the evolution of the child society at different maturity levels to adulthood. Analyzes the developmental tasks and adjustment problems associated with winning, belonging, and playing roles in the peer group.

EDHD 721 Learning Theory and the Educative Process I. (3) Provides a systematic review of the major theories and their impact on Education. Considers factors that influence learning.

EDHD 722 Learning Theory and the Educative Process II. (3) Prerequisite: EDUC 300 or equivalent. Provides an exploration in depth of current theoretical and research developments in the field of human learning, especially as related to educational processes. Consideres factors that influence learning.

EDHD 730 Field Program in Child Study I. (3) Prerequisite: Consent of instructor. Offers introductory training and apprenticeship preparing persons to become staff members in Human Development workshops, consultants in child study field programs and coordinators of municipal or regional child study programs for teachers or parents. Extensive field experience is provided. In general, this training is open only to persons who have passed their preliminary examinations for the doctorate with a major in Human Development or Psychology.

EDHD 731 Field Program in Child Study II. (3) Prerequisite: EDHD 730 or consent of instructor. Offers advanced training and apprenticeship preparing persons to become staff members in Human Development workshops, consultants to child study field programs and coordinators of municipal or regional child study programs for teachers or parents extensive field experience is provided. In general, this training is open only to persons who have passed their preliminary examinations for the doctorate with a major in Human Development or Psychology.

EDHD 779 Seminars in Special Topics in Human Development. (2–6) Prerequisite: Consent of instructor.

EDHD 780 Research Methods in Human Development (3) Prerequisite: EDMS 651 or equivalent. Potentials and limitations of empirical observation for contributing to human development knowledge, locating and evaluating relevant human development research, and choosing and applying statistical techniques to human development problems.

EDHD 798 Special Problems in Education. (1–6) Master's, AGS, or doctoral candidates who desire to pursue special research problems under the direction of their advisors may register for credit under this number.

EDHD 799 Master's Thesis Research. (1–6) Registration required to the extent of six hours for master's thesis.

EDHD 810 Physical Processes in Human Development I. (3) Prerequisite: Admission to doctoral program in Human Development Education. Examines the physiology of homeostasis including the roles of temperature, biochemical factors, respiration, circulation, digestion, and utilization of energy as these influence the health, functioning, and behavior of human beings.

EDHD 811 Physical Processes in Human Development II. (3) Prerequisite: Admission to doctoral program in Human Development Education. Focuses upon the physiology of communication including a study of the roles of the nervous system, endocrines, nucleic acids, and pheramones as these influence the health, functioning and behavior of human beings.

EDHD 820 Socialization Processes in Human Development I. (3) Prerequisite: Admission to doctoral program in Human Development Education. Study of comparative cultures serve as a medium for analyzing the processes by which human beings internalize the culture of the society in which they live.

EDHD 821 Socialization Processes in Human Development II. (3) Prerequisite: EDHD 820 or consent of instructor. Study of major sub-cultures in the United States, their institutions, training procedures, and their characteristic human expressions in folk-knowledge, habits, attitudes, values, goals, and adjustment patterns as these relate to the processes in which human beings in our society internalize the culture in which they live.

EDHD 830 Self Processes in Human Development I. (3) Prerequisite: Admission to doctoral program in Human Development Education. The personality theories of Freud, Jung, Adler, Horney, Fromm, Sullivan, Murray, Lewin, and Allport.

EDHD 831 Self Processes in Human Development II. (3) Prerequisite: EDHD 830 or consent of instructor. The personality theories of Erickson, Rogers, Maslow, and others. Synthesis of the student's theory of personality.

EDHD 860 Synthesis Human Development Concepts. (3) Prerequisites: EDHD 810, 820 and 830. A seminar wherein advanced students work toward a personal synthesis of their own concepts in human growth and development. Emphasis is placed on seeing the dynamic interrelations between all process in the behavior and development of an individual.

EDHD 888 Apprenticeship in Education. (1–8) Apprenticeships in the major area of study are available to selected students whose application for an apprenticeship has been approved by the Education faculty. Each apprentice is assigned to work for at least a semester full-time or the equivalent with an appropriate staff member of a cooperating school, school system, or educational institution or agency. The sponsor of the apprentice maintains a close working relationship with the apprentice and the other persons involved. Prerequisites: Teaching experience, a Master's Degree in Education, and at least six semester hours in Education at the University of Maryland. Note: The total number of credits which a student may earn in EDHD 489, 888 and 889 is limited to a maximum of twenty (20) semester hours.

EDHD 889 Internship in Education. (3–8) Internships in the major area of study are available to selected students who have teaching experience. The following groups of students are eligible: (A) Any student who has been advanced to candidacy for the doctor's degree; and (B) Any student who receives special approval by the Education faculty for an internship, provided that prior to taking an internship, such student shall have completed at least 60 semester hours of graduate work, including at least six semester hours in Education at the University of Maryland. Each intern is assigned to work on a full-time basis for at least a semester with an appropriate staff member in a cooperating school, school system, or educational institution or agency. The internship must be taken in a school situation different from the one where the student is regularly employed. The intern's sponsor maintains a close working relationship with the intern and the other persons involved. Note: The total number of credits which a student may earn in EDHD 489, 888, and 889 is limited to a maximum of twenty (20) semester hours.

EDHD 899 Doctoral Dissertation Research. (1–8) Registration required to the extent of 6–9 hours for an ED.D. project and 12–18 hours for a Ph.D. dissertation.

Industrial Education Program

Professor and Chairman: Maley
Professors: Harrison, Hornbake (Emeritus), Luetkemeyer
Associate Professors: Beatty, Herschbach, Mietus, Stough, Tierney
Assistant Professors: Elkins, Gemmill, Starkweather

The graduate programs in Industrial Education are designed to prepare specialized personnel in all fields related to Industrial Education. These fields include programs both in education and in industry. Programs related to education prepare personnel for teaching, administration, and supervisory positions in local schools or in related state and federal agencies, as well as preparations for university teaching and research. Programs designed for industrial personnel are primarily in industrial training, supervision, and production.

Admission and Degree Information

At the master's degree level for M.A. (thesis) and M.Ed., programs are offered in four areas: Industrial Technology, Industrial Arts Education, Vocational-Technical Education, and Technical Education. The M.A. (non-thesis option) is offered in Industrial Technology. the Department has two separate doctoral programs (Ph.D. and Ed.D.) in the allied fields of Industrial Arts Education and Vocational-Industrial Education. The Department also offers an Advanced Graduate Specialist Certificate in both fields.

Every graduate program in the Department is developed on an individual basis to meet the personal needs of the graduate student. At the same time, however, the graduate student is expected to have achieved certain specified objectives upon completion of his/her program. The student should exhibit: competence in a major field of Industrial Education; ability to analyze, conduct, and report research findings; and a broad understanding of the relationships of education and industry as social institutions in our technological culture.

Facilities and Special Resources

In addition to the extensive library and computer facilities available on the College Park Campus, other institutions located within the Washington area are also available for research and consul-

lation services. These institutions include the Library of Congress, Smithsonian Institution, U.S. Office of Education, American Industrial Arts Association, American Vocational Association, and the National Medical Library.

Financial Assistance

Some Graduate Assistantships are available to qualified graduate students.

Additional Information

For information and a departmental brochure, please write to the Director of the Graduate Program.

Courses

EDIN 400 Technology Activities for the Elementary School. (3) Experience in the development and use of technology and career education instructional materials for construction activities in an interdisciplinary approach to elementary school education.

EDIN 410 Administration and Program Development in Industrial Arts. (3) Principles and practices of program development and supervision with reference to the role of the departmental chairperson in vocational, technical, and industrial arts programs at the secondary and post-secondary levels.

EDIN 412 Management of Physical Facilities in Industrial Arts and Vocational Education. (3) Principles, practices, and theory related to the role of the departmental chairperson charged with the management of the physical facilities in vocational, technical, and industrial arts laboratories.

EDIN 415 Research and Experimentation in Industrial Arts. (3) This is a laboratory-seminar course designed to develop persons capable of planning, directing and evaluating effective research and experimentation procedures with the materials, products and processes of industry.

EDIN 416 Industrial Hygiene. (3) Introduction to the concept of industrial hygiene and environmental health. Evaluation techniques, instrumentation for identification of problems; design parameters for achieving control over environmental epidemological and toxicological hazards.

EDIN 421 Industrial Arts in Special Education. (3) Four hours laboratory per week, one hour lecture. Prerequisite: EDSP 470 and 471 or consent of instructor. This course provides experiences of a technical and theoretical nature in industrial processes applicable for classroom use. Emphasis is placed on individual research in the specific area of one major interest in Special Education.

EDIN 425 Industrial Training in Industry I. (3) An overview of the function of industrial training, including types of programs, their organization, development, and evaluation.

EDIN 426 Industrial Training in Industry II. (3) Prerequisite: EDIN 425. Studies of training programs in a variety of industries, including plant program visitation, training program development, and analysis of industrial training research.

EDIN 427 Experimental Electronics. (2) Emphasis on student investigation of an area of electronics of particular interest or usefulness at a depth appropriate for student background and need. Course focuses on student-based objectives relating to one or more of the following: digital circuitry, communication, energy conversion, test equipment utilization, analogue circuitry. Six hours of laboratory per week.

EDIN 433 Advanced Topics in Power Technology. (3) Prerequisite: EDIN 233 or equivalent. Two hours of lecture, four hours of laboratory per week. Intended for the advanced undergraduate or graduate student who wishes to develop a competency in building and evaluating the performance of energy transmission, control and converter systems. Methane digestors, solar collectors, electric motors, steam turbines, and fluid power systems.

EDIN 434 Color Reproduction in Graphic Communications. (3) Two hours of lecture, four hours of laboratory per week. Prerequisite: EDIN 334 or equivalent. An advanced course on the theory and processes of color graphic reproduction. Continuous tone color photography, flat color preparation, process color separations and the reproduction of a multi-color product on a semi-or automatic printing press.

EDIN 443 Industrial Safety Education I. (2) This course deals briefly with the history and development of effective safety programs in modern industry and treats causes, effects and values of industrial safety education inclusive of fire prevention and hazard controls.

EDIN 444 Industrial Safety Education II. (2) In this course exemplary safety practiced are studies through conference discussions, group demonstration, and organized plant visits to selected industrial situations. Methods of fire precautions and safety practices are emphasized. Evaluative criteria in safety programs are formulated.

EDIn 445 Systems Safety Analysis. (3) The development of systems safety, a review of probability concepts and the application of systems technique to industrial safety problems. Hazard mode and effect, fault free analysis and human factors considerations.

EDIN 450 Training Aids Development. (3) Study of the aids in common use as to their source and application. Special emphasis is placed on principles to be observed in making aids useful to laboratory teachers. Actual construction and application of such devices will be required.

EDIN 457 Tests and Measurements. (3) The construction of objective tests for occupational and vocational subjects.

EDIN 460 Essentials of Design. (2) Two laboratory periods a week. Prerequisite: EDIN 101 and basic laboratory work. A study of the basic principles of design and practice in their application to the construction of laboratory projects.

EDIN 461 Principles of Vocational Guidance. (3) This course identifies and applies the underlying principles of guidance to the problems of educational and vocational adjustment of students.

EDIN 462 Occupational Analysis and Course Construction. (3) Provides a working knowledge of occupational and job analysis and applies the techniques in building and reorganizing courses of study for effective use in vocational and occupational schools.

EDIN 464 Laboratory Organization and Management. (3) This course covers the basic elements of organizing and managing an industrial education program including the selection of equipment and the arrangement of the shop.

EDIN 465 Modern Industry. (3) This course provides an overview of manufacturing industry in the American social, economic and culture pattern. Representative basic industries are studied from the viewpoints of personnel and management organization, industrial relations, production procedures, distribution of products, and the like.

EDIN 466 Educational Foundations of Industrial Arts. (3) A study of the factors which place industrial arts education in any well-rounded program of general education.

EDIN 467 Problems in Occupational Education. (3) The purpose of this course is to secure, assemble, organize, and interpret data relative to the scope, character and effectiveness of occupational education.

EDIN 470 Numerical Control in Manufacturing. (3) The historical development of numerical control (N/C) in manufacturing, recent industrial trends in N/C, and a variety of N/C equipment and support services. N/C machine operations: machine motions, positioning control systems, N/C tapes and their preparation, manual and computer assisted (APT III) part programming. Experience in product design, part programming, and product machining.

EDIN 471 History and Principles of Vocational Education. (3) An overview of the development of Vocational Education from primitive times to the present with special emphasis given to the vocational education movement with the American program of public education.

EDIN 475 Recent Technological Developments in Products and Processes. (3) This course is designed to give the student an understanding of recent technological developments as they pertain to the products and processes of industry. The nature of the newer products and processes is studied as well as their effect upon modern industry and/or society.

EDIN 476 Application of Technology to Societal Problems. (3) A study of alternative solutions of a technological nature with respect to such areas as housing, transportation, energy, communications, production, trash and waste disposal, water development, and pollution control.

EDIN 481 Manufacture and Use of Inorganic Nonmetallic Materials. (3) Prerequisite: EDIN 381 or equivalent. Two hours of lecture, four hours laboratory per week. Fabrication of products from calculated compositions; application of forming process; utilization of compositions; experiences with property analysis and product design.

EDIN 487 Field Experience in Education. (1–4) Prerequisites: At least six semester hours in Education at the University of Maryland plus such other prerequisites as may be set by the major area in which the experience is to be taken. Planned field experience may be provided for selected students who have had teaching experience and whose application for such field experience has been approved by the Education faculty. Field experience is offered in a given area to both major and nonmajor students. Note: The total number of credits which a student may earn in EDIN 487, 888, and 889 is limited to a maximum of 20 semester hours.

EDIN 488 Special Problems in Education. (1–3) Prerequisite: Consent of instructor. Available only to mature students who have definite plans for individual study of approved problems.

EDIN 491 Plastics Design and Equipment Selection. (3) Lecture and laboratory. Prerequisite: EDIN 391 or permission of the department. Includes experience with material selection, product design, mold design, auxiliary equipment and fixtures.

EDIN 499 Workshops, Clinics, and Institutes. (1–6) The maximum number of credits that may be earned under this course symbol toward any degree is six semester hours; the symbol may be used two or more times until six semester hours have been reached. The following type of educational enterprise may be scheduled under this course heading: workshops conducted by the College of Education (or developed cooperatively with other colleges and universities) and not otherwise covered in the present course listing; clinical experiences in pupil-testing centers, reading clinics, speech therapy laboratories, and Special Education centers; institutes developed around specific topics or problems and intended for designated groups such as school superintendents, principals and supervisors.

EDIN 607 Philosophy of Industrial Arts Education. (3) An overview of the development of the industrial arts movement and the philosophical framework upon which it was founded. Special emphasis is given to the contemporary movements in industrial arts and their theoretical foundations.

EDIN 614 School Shop Planning and Equipment Selection. (3) Deals with the principles and problems of providing the physical facilities for industrial education programs. The selection, arrangement and placement of equipment are covered as well as the determinating of laboratory space requirements, utility services and storage requirements for various types of industrial education programs.

EDIN 616 Supervision of Industrial Arts. (3) Deals with the nature and function of the supervisory function in the industrial arts field. The administrative as well as the supervisory responsibilities, techniques, practices and personal qualifications of the industrial arts supervisor are covered.

EDIN 620 Organization, Administration and Supervision of Vocational Education. (3)

EDIN 640 Research in Industrial Arts and Vocational Education. (2) Offered by arrangement for persons who are conducting research in the areas of industrial arts and vocational education.

EDIN 641 Content and Method of Industrial Arts. (3) Various methods and procedures used in curriculum development are examined and those suited to the field of Industrial Arts Education are applied. Methods of and devices for industrial arts instruction are studied and practiced.

EDIN 642 Coordination in Work-Experience Programs. (3) Surveys and evaluates the qualifications and duties of a teacher-coordinator in a work-experience program. Deals particularly with evolving patterns in city and county schools in Maryland, and is designed to help teacher-coordinators, guidance counselors, and others in the supervisory and adminis-

trative personnel concerned with the functioning relationships of part-time cooperative education in a comprehensive educational program.

EDIN 647 Seminar in Industrial Arts and Vocational Education. (2)

EDIN 650 Teacher Education in Industrial Arts. (3) This course is intended for the industrial arts teacher educator at the college level. It deals with the function and historical development of industrial arts teacher education. Other areas of content include administration program and program development, physical facilities and requirements, staff organization and relationships, college-secondary school relationships, philosophy and evaluation.

EDIN 798 Special Problems in Education. (1–6) Master's, AGS, or doctoral candidates who desire to pursue special research problems under the direction of their advisers may register for credit under this number. Course card must have the title of the problem and the name of the faculty member under whom the work will be done.

EDIN 799 Master's Thesis Research. (1–6) Registration required to the extent of 6 hours for master's thesis.

EDIN 888 Apprenticeship in Education. (1–8) Apprenticeships in the major area of study are available to selected students whose application for an apprenticeship has been approved by the Education faculty. Each apprentice is assigned to work for at least a semester full-time or the equivalent with an appropriate staff member of a cooperating school, school system, or educational institution or agency. The sponsor of the apprentice maintains a close working relationship with the apprentice and the other persons involved. Prerequisites: Teaching experience, a Master's Degree in Education, and at least six semester hours in Education at the University of Maryland. **Note:** The total number of credits which a student may earn in EDIN 489, 888 and 889 is limited to a maximum of twenty (20) semester hours.

EDIN 889 Internship in Education. (3–8) Internships in the major area of study are available to selected students who have teaching experience. The following groups of students are eligible: (a) Any student who has been advanced to candidacy for the doctor's degree; and (b) Any student who receives special approval by the Education faculty for an internship, provided that prior to taking an internship, such student shall have completed at least 60 semester hours of graduate work, including at least six semester hours in Education at the University of Maryland. Each intern is assigned to work on a full-time basis for at least a semester with an appropriate staff member in a cooperating school, school system, or educational institution or agency. The internship must be taken in a school situation different for the one where the student is regularly employed. The intern's sponsor maintains a close working relationship with the intern and the other persons involved. **Note:** The total number of credits which a student may earn in EDIN 489, 888, and 889 is limited to a maximum of twenty (20) semester hours.

EDIN 899 Doctoral Dissertation Research. (1–8) Registration required to the extent of 6–9 hours for an Ed.D. project and 12–18 hours for a Ph.D. dissertation.

Journalism Program

Professor and Dean: Martin
Professors: Grunig, Hiebert, Merrill
Associate Professors: Beasley, Levy
Assistant Professors: Barkin, Nam, Nunamaker, McElreath, Patrick, Zanot

The College of Journalism offers a Master of Arts degree in Journalism and, with the Department of Communication Arts and Theatre, the Ph.D. in Public Communication. The Master's degree is primarily a professional degree intended for students who wish to deepen their understanding of the communication professions and their preparation for those professions. It thus includes advanced practical courses and courses in communication theory and research. Most M.A. students specialize in public affairs reporting, public relations, international communication, science communication, broadcast journalism, advertising, opinion and evaluative research, political communication, and education and journalism.

The Ph.D. in Public Communication is an interdisciplinary program embracing the College of Journalism and the three divisions of Communication Arts and Theatre: Radio-Television-Film, Speech Communication, and Theatre. The Ph.D. prepares students for creative scholarship and research. It emphasizes both the necessary techniques and skills to conduct research and the ability to think innovatively about problems of public communication. Within this Ph.D. program, the College of Journalism stresses four emphases: political and governmental communication, public relations and organizational communication, international communication, and science and medical communication. Other areas of emphasis in the Public Communication program include rhetoric and public address, broadcast communication, theatrical theory and aesthetics, theatre history and cinema history and aesthetics. For complete information on admission and degree requirements, see the "Public Communication Program" entry. research in mass communication.

Admission and Degree Information

The Master's degree is a one-year program, with the typical student taking 12 hours of graduate work in the fall, 12 hours in the spring, and 6 hours of thesis or non-thesis option seminars in the summer. Work on the degree may be started at any time. JOUR 600 is required for the M.A. in Journalism, as is either JOUR 610 or JOUR 612.

Applicants seeking admission to the master's program should hold a bachelor's degree from a recognized institution of higher learning. Undergraduate study of Journalism or professional experience in journalistic fields are helpful but not required. Students who have majored in some other field as undergraduates are required to make up professional deficiencies by taking five selected courses in journalism without graduate credit. Completion of the general aptitude portion of the Graduate Record Examination is required, and three letters of recommendation must be submitted.

Facilities and Special Resources

The University of Maryland is in an advantageous location for the study of journalism. It is within easy reach of five of the nation's top newspapers; *The Baltimore Sun, Baltimore News-American, The Washington Post, The Washington Star,* and *Wall Street Journal.* It is also near the Washington press corps, the large Washington bureaus of the Associated Press, United Press International, the New York Times, and most important American and foreign newspapers; NBC, CBS, and ABC, and other broadcasting news bureaus; and news magazines and major book publishing offices. It is at the doorstep of the nation's major newsmakers in the executive, legislative, and judicial branches of the Federal Government.

Special facilities include photographic, news editing, and advertising laboratories, as well as a reading room with daily and weekly newspapers, magazines, and clipping and bulletin files.

Financial Assistance

The College of Journalism offers a limited number of assistantships, in exchange for teaching or research assistance in journalism of up to 20 hours per week. Internships in various offices both on and off campus also are available to journalism graduate students as are some fellowships and scholarships.

Courses

JOUR 410 History of Mass Communication (3) Development of newspapers, magazines, radio, television and motion pictures as media of mass communication. Analysis of the influences of the media on the historical development of America.

JOUR 420 Government and Mass Communication (3) Relationship between news media and government, media coverage of government and politics; governmental and political information and persuasion techniques.

JOUR 430 Comparative Mass Communication Systems (3) Comparative analysis of the role of the press in different societies.

JOUR 440 Public Opinion and Mass Communication (3) Measurement of public opinion and media habits; role of the mass media in the formation of public opinion.

JOUR 450 Mass Media in Society (3) Ethical, moral, political, economic, and social consideration of mass communication. media in the formation of public opinion.

JOUR 459 Special Topics in Mass Communication. (3) Issues of special concern and current interest. Open to all students. Repeatable to a maximum of six credits provided the topic differs.

JOUR 460 Women in the Media (3) Participation and portrayal of women in the mass media from colonial to contemporary times.

JOUR 470 Newspaper Management (3) Organization, operation, and administration of the departments of a newspaper: advertising, business-finance, circulation, news-editorial, personnel, production, and promotion.

JOUR 480 Mass Communication Research (3) Prerequisite: MATH 110 or equivalent; students are encouraged to have completed the theory and technique courses in their major sequence. Communication research methods used in measuring public opinion and evaluating public relations, advertising, and mass media programs and materials.

JOUR 490 Advising Student Publications (3) Journalistic writing and editing in student newspapers, yearbooks, and magazines; libel and policy; curriculum and teaching procedures; role of student publications.

JOUR 491 Policy, Censorship, and Legal Problems of Student Publications (3) Censorship problems and court cases; legal rights of the student press; formulation of policy and legal guidelines. Not open to students with credit in JOUR 400.

JOUR 492 Typography and Layout for Student Publications (3) Type design, type families, graphics, art, photography, and editorial and advertisement layout of school newspapers, year books, and magazines. Not open to students with credit in JOUR 202.

JOUR 493 Advanced Techniques for Student Publication Advisors (3) Interpretative and investigative reporting; interviewing and scientific survey methods; curriculum and courses for high school and community colleges; textbooks, teaching units, and resource aids.

JOUR 497 Professional Seminar. (3) Prerequisites: JOUR 200, JOUR 201 and consent of instructor. Projects and discussions relating professional work experience to the study of journalism. Limited to students who participated in an approved summer work experience after the junior year.

JOUR 499 Independent Study. (1–3) Individual projects in journalism. May be repeated to a maximum of three hours.

JOUR 600 Research Methods in Mass Communication. (3)

JOUR 610 Seminar in Mass Media and Society. (3) Analysis and discussion of the interrelationships between the mass media and society, including various social and cultural elements of modern society; responsibilities of the mass media and the mass communicator.

JOUR 612 Theories of Mass Communication. (3)

JOUR 620 Seminar in Public Affairs Reporting. (3) Prerequisite: JOUR 320.

JOUR 621 Interpretation of Contemporary Affairs. (3) Prerequisite: JOUR 320.

JOUR 630 Seminar in Corporate Communication. (3)

JOUR 640 Mass Culture and Mass Communication. (3)

JOUR 680 Science Communication. (3) Advanced professional training in science reporting and writing for the mass media and in technical communication to specialized audiences. Communication behaviors of scientists and audiences. Application of communication theory and the history and philosophy of science to science writing.

JOUR 700 Seminar in Mass Media Law. (3)

JOUR 710 Seminar in Mass Media History. (3)

JOUR 720 Seminar in Government and Mass Communication. (3)

JOUR 721 Seminar in Urban Mass Communication. (3)

JOUR 730 Seminar in Comparative Mass Communication. (3)

JOUR 731 Cross-Cultural Communication. (3)

JOUR 760 Seminar in Broadcast News. (3) Descriptive and critical analysis of broadcast news; methods of evaluation of news judgments; decision-making and organizational aspects of the broadcast news industry.

JOUR 799 Master's Thesis Research. (1–6)

JOUR 800 Seminar in Critical Analysis. (3)

JOUR 810 Special Problems in Communication. (3)

JOUR 812 Seminar in Communication Theories. (3)

Library and Information Services Program

Professors: Bundy, Kidd, Liesener, Olson, Reynolds, Soergel, Wasserman
Associate Professors: MacLeod, Wellisch, Wright
Assistant Professors: Fitzgibbons, Johnson, Keller, McCrank, Travis, White
Lecturers: Batty, Cunningham, Slater

The College offers programs leading to the Master of Library Science (M.L.S.) degree and the Ph.D. in Library Science. A course of directed study leading to the M.A. in History and the M.L.S. is available to students desiring advanced studies in the field of archives, manuscripts, and historical collections. (For details see the entry in this catalog following History.) The College also provides the option for advanced students who are not degree candidates to participate in regular courses, workshops and seminars. Indeed, there is a new emphasis within CLIS on continuing education, and a pilot project will soon begin on which an assessment of needs will be made and an off campus site will be established for continuing education courses.

The degree programs are avowedly academic in the sense that the main emphasis is put on the conceptual foundations of librarianship. The objective is to integrate the products of scholarly research in the field with the concerns surrounding current and expected conditions of professional practice. A prime example of such concerns emerges from the introduction and growing use of high technology in library operations.

The programs are all regarded as evolutionary in character. That is, change and adaptation are considered the normal state of affairs. The process is considered to be a reciprocal one in that the College's programs are influenced by the developments in the conditions of professional practice *and* in that, through the scholarly and professional efforts of faculty and the capabilities engendered in students, advances in quality and scope of library services can be attained.

The conventional mode of specialization within librarianship is by type of library. Thus, the programs of the College provide for specialization in school, public, academic and special library operations. The school-media area specialization ordinarily leads to certification. Other specializations have less formal outcomes, and considerable flexibility exists for the pursuit by students of their own individual interests.

Students should be aware also that new forms of specialization are coming based upon a growing appreciation of the interrelationships between librarianship and such fields as mass communication, business and public administration, and computer technology.

Close ties are being forged with other departments in the University to ensure that the widest range of options is made available to students and to facilitate the research efforts of the faculty.

Admission and Degree Information

Admission as a student to the College is limited to individuals who hold the bachelor's degree from recognized colleges, universities or professional schools in this country or abroad or to those who can provide evidence of successful completion of equivalent courses of study. The individual's undergraduate academic record is of primary importance, but other factors are also taken into account in reviewing applications. The potential student's performance in the aptitude tests of the Graduate Record Examination, letters of personal recommendation, and information gained from personal interviews with potential students are considered. Reports related to the applicant's intellectual and personal development as an undergraduate are sometimes considered, as are such factors as employment experience, military service and other related activities when they appear to be relevant in a particular case as part of the admissions review process. All these factors are considered significant in assessing the applicant's capacity and motivation for graduate work in the College and for his later performance as a member of the library profession. The Admissions Committee will consider exceptions to and waiver of requirements in some cases.

Programs for Master's candidates are planned individually, and faculty advisors recommend courses they think most appropriate for each student. The required pro-seminar and introductory courses in the organization of knowledge and reference provide a base from which the student can build a purposeful program fitted to his or her personal needs and aspirations. Reflecting the multidisciplinary nature of librarianship and its continuing need for reliance upon insights from supportive intellectual disciplines, students have a high degree of flexibility in the elective portions of their work. Their courses are not restricted to those within the programs but can include relevant courses from other parts of the University.

The Field Study in Library Service provides an internship program designed to familiarize students with library operations through unpaid supervised experience and/or to provide opportunity to perform a study to solve a specific problem in a suitable library or other information agency.

The Master of Library Science degree will be awarded to the student who successfully completes a program of 36 hours with an average of B or better within three years from first registration in the program. Under a full-time program a student normally completes 12 semester hours during the fall and spring semesters and 12 hours during the summer terms. Part-time students are also admitted to the program. A night/weekend program has recently been initiated in response to the requests of potential students for classes to be held during other than the normal daytime working hours. Students wishing admission to the night/weekend program should apply to the College following the same procedures as any other student. All students should bear in mind that the three-year time limit on the degree is still in force. No thesis or comprehensive examination is required for the M.L.S. degree.

The Ph.D. program requires the equivalent of three years of full-time work, normally divided into approximately two years of formal coursework (60 semester hours) and one year of work on the dissertation.

The College has no language requirement unless the individual student's specialization or dissertation requires it.

Facilities and Special Resources

The College of Library and Information Services maintains its own library and information service within the College. The Library is an information center, organized for the express purpose of affording the College's faculty and research staff the same kind of modern special library service as that provided by other forward looking agencies committed to this ideal. The University of Maryland has an excellent computer service. In addition, the College has a Data Processing Laboratory which serves as a resource facility for instruction in the areas of library automation and information processing, for faculty and student research, as well as support for the CLIS Library. The Instructional Development and Support Center is another service arm of the College. It was established for the purpose of providing instructional development and support and audiovisual materials production for the faculty and the students. Students are provided with the opportunity to experience nonprint instructional materials production and the utilization of audiovisual equipment.

A recently approved course of directed study leading to the M.A. in History and the M.L.S. is now available to students desiring advanced studies in the field of archives, manuscripts, and historical collections. For details see the entry in this catalog following History.

Financial Assistance

A number of fellowships and assistantships are available for students enrolled in the College. Loan funds administered by the University and federally insured loans are also available. Public libraries in the region as well as other local organizations offer a few stipends and scholarships. In addition, a student in the College is eligible to apply for scholarships, fellowships and grants from national organizations awarded for graduate study in librarianship. Information on the availability of such awards may be requested from the Director of Admissions, College of Library and Information Services.

M.A. in History and the M.L.S. Course of Study.

(*See entry after History Program*)

Courses

LBSC 499 Workshops, Clinics, and Institutes. (1–9) Workshops, clinics, and institutes developed around specific topics or problems primarily for practicing librarians. Repeatable to a maximum of nine credit hours.

LBSC 600 Proseminar—The Development and Operation of Libraries and Information Services. (3–6) Background and orientation needed for ad-

vanced study in Librarianship and Information Science. Covers the major problems in the development and provision of Information Services; the structure, functions, and economics of information service organizations; and the processes by which change is brought about in the quality of Information Services.

LBSC 603 Library Systems Analysis. (3) Introduction to the total systems approach to library and information problems, emphasizing administrative and managerial decision-making. Will give a scientific management framework, terms for defining a system, and its problems, and a set of tools, techniques, and methods to aid in analyzing and solving these problems. Topics to be covered include model building, flowcharting, motion and time study, cost analyses, systems design, management information, and cost-effectiveness and planning-programming-budget systems.

LBSC 611 Archives and Libraries in Western Civilization. (3) An institutional approach to the study of western civilization by surveying from the earliest records to the present, the development of archives, libraries, their materials and personnel. Emphasis on the socio-economic forces controlling the development of these institutions, their proliferation and specialization, and their cultural role in the formation and continuation of western civilization.

LBSC 612 History of Books and Printing. (3) The history of the book in its various forms from the earliest surviving records to contemporary production, including the origin and evolution of the alphabet and scripts, writing materials, manuscripts and decorative arts leading to the book as known today. The invention of printing, leading printers and type designs, and book distribution during both the hand and machine press periods.

LBSC 621 Library Service to the Disadvantaged. (3) Approaches, adaptations and potentials of the public library in relation to the problem of poverty. Includes field experience in the school's laboratory library.

LBSC 630 Library Administration. (3) An introduction to administrative theory and principles and their implications and applications to managerial activity in libraries.

LBSC 641 Selection and Evaluation of Instructional Media. (3) Development of criteria for selection and evaluation of instructional materials for classroom, school and system use; includes measures of readability, listenability, visual difficulty and interest level.

LBSC 643 Library Media Specialists in Educational Systems. (3) The educational context in which library media specialists function. The activities of library media specialists within the system. The development of processes and products in support of instruction at all levels from elementary through post-secondary. The role of library media specialists as change agents in faculty and instructional development, program and product evaluation, and instructional design principles.

LBSC 645 Children's Literature and Materials. (3) A survey of literature and other media of communication and the criteria in evaluating such materials as they relate to the needs, interests and capability of the child.

LBSC 651 Introduction to Reference and Information Services. (3) Information and reference systems, services, and tools provided in libraries and information centers. Problems and concepts of communication, question negotiation, bibliographic control, and search processes are considered. Major types of information sources and modes of information delivery are introduced.

LBSC 671 Organization of Knowledge in Libraries I. (3) Principles of the organization of library materials for physical and intellectual access. Concepts and problems involved in subject cataloging, classification, and descriptive cataloging. Major systems and rules in use in current practice, particularly those systems popular in the United States.

LBSC 675 Introduction to Information Storage and Retrieval (ISAR) Systems. (3) Micro-organization of information services and basic principles underlying both manual and mechanized ISAR systems, including the conceptual structure of indexing languages and search strategies, file organization, typology of classifications, abstracting, and indexing.

LBSC 690 Introduction to Data Processing for Libraries. (3) Basic principles of data processing and the ways in which data processing systems have been applied to library problems. Lectures cover the application of punched card processing to library operations; and introduction to systems analysis and the methodology for establishing systems requirements; and the application of electronic data processing systems to library operations. In the laboratory, the fundamentals of computer programming are provided for developing and running computer programs designed to solve typical library problems.

LBSC 701 Research Methods in Library and Information Activity. (3) The techniques and strategies of research and their implications for the definition, investigation and evaluation of library problems.

LBSC 702 Library Systems. (3) Evolution and current patterns of regional library development, considering the economic, legal, service and management problems associated with library systems as well as the significance of state and federal programs and national information networks.

LBSC 703 Seminar in Information Transfer. (3) Prerequisite: LBSC 704, or permission of instructor. Discussion of significant problems in information science: Topics include fundamental concepts, theory, methodology, current research.

LBSC 704 Seminar in Information Science. (3) Introduction to the fundamentals in Information Science. The nature of messages in human and machine communication are approached from the viewpoint of the physical, psychological, and logical transformations which they undergo in their paths from message sender to recipient. Cybernetic variety, basic constraints or variety in information systems and classes in their uses in search and communications are studied, as well as, models, and optimization and mechanization of access to messages for communication of data, information, knowledge.

LBSC 706 Seminar in International and Comparative Librarianship and Information Science. (3) Compares and contrasts bibliographical systems, institutions, service arrangements, and professional patterns in developed and developing cultures. Libraries, information organizations and international information systems are viewed against the backdrop of national cultures, and the influence of the social, political and economic factors upon these forms are considered.

LBSC 707 Field Study in Library Service. (3) Prerequisite: LBSC 600, 651, 671, 690 and permission of instructor. Familiarization of students with library operations through unpaid, supervised experience and/or the opportunity to perform a study to solve a specific problem in a suitable library or other information agency.

LBSC 708 Special Topics in Library and Information Service. (3) No student may earn more than 9 hours under LBSC 708, more than 9 hours under LBSC 709, nor more than a total of 12 hours in both LBSC 708 and LBSC 709.

LBSC 709 Independent Study. (1–3) Designed to permit intensive individual study, reading or research in an area of specialized interest under faculty supervision. Registration is limited to the advanced student who has the approval of his advisors and of the faculty member involved. No student may earn more than 9 hours under LBSC 708, more than 9 hours under LBSC 709, nor more than a total of 12 hours in both LBSC 708 and 709.

LBSC 712 Introduction to Codicology and Critical Bibliography. (3) A research-oriented seminar. The physical form of western historical and literary documents, manuscript books, and both hand and machine press book production. Theoretical concerns in research associated with textual criticism and descriptive bibliography, as well as practical experience in the descriptive cataloging of rare books.

LBSC 722 Communication and Libraries. (3) Theory and research in the multi-discipline domain of communication. Inquiry is directed into such diverse matters as coding theory, linguistic analysis, decision theory, network concepts, etc. Connections are pointed-out between communication research and library practice.

LBSC 723 Libraries and Information Services in the Social Process. (3) The focus is upon the policy process. Key elements in the societal political environment which influence decision-making in libraries and information service facilities are identified and interrelated, such as legislation, citizen participation, organized groups, mass media, professional associations, technological changes, financial support. The significance of such contemporary issues as censorship, manpower, community control, and automation are considered in this context.

LBSC 724 Public Library in the Political Process. (3) Seminar on the principal influences which affect the patterns of organization, support and service patterns of public libraries based upon theoretical and case studies.

LBSC 727 Science Information and the Organization of Science. (3)

LBSC 730 Advanced Organization and Administration of Libraries and Information Services. (3) The student's theoretical understanding of organization and administration will be advanced by intensive study in the various sub-fields of contemporary library and information developments.

LBSC 733 Seminar in Library and Information Networks. (3) Explores the inter-library cooperative phenomenon and analyzes critical issues in network planning, economics, organization, technology, and services.

LBSC 734 Seminar in the Academic Library. (3) A seminar on the academic library within the framework of higher education, treating problems of programs, collections, support, planning and physical plant.

LBSC 735 Curatorship of Historical Collections. (3) An introduction to the care and unique administrative problems of special collections which are historical in nature. Emphasis on American repositories and the interplay between libraries as parent institutions and collections in manuscripts and archives, state and local history, museum libraries, oral history, and rare books.

LBSC 737 Seminar in the Special Library and Information Center. (3) A seminar on the development, the uses, the objectives, the philosophy and the particular systems employed in special library service.

LBSC 741 Seminar in the School Library. (3)

LBSC 744 Field Study in School Library Media Programs. (3) Prerequisite: LBSC 741 and permission of instructor. A practicum and seminar providing students with opportunities to observe the operation of a variety of library media programs at different levels (elementary, middle and secondary), to participate under supervision in the various operations and activities of ongoing library media programs, and to critically analyze their performance and experiences.

LBSC 745 Storytelling Materials and Techniques. (3) Literary sources are studied and instruction and practice in oral techniques are offered.

LBSC 748 Advanced Seminar in Children's Literature. (3) Prerequisite: LBSC 636 or permission of the instructor. Selected topics in literature for children including historical aspects, individual authors, major themes and trends.

LBSC 750 Advanced Reference Services. (3) Theoretical and administrative considerations, analysis of research problems, and directed activity in bibliographic method and search techniques in large collections.

LBSC 751 Literature and Research in the Humanities. (3) Bibliographic organization, information structure and trends in the direction of research in the principal humanistic disciplines.

LBSC 752 Literature and Research in the Arts. (3) An advanced reference course designed as an interdisciplinary introduction to the bibliography and trends in research and library service in the fields of music, dance, film and theater, architecture and archeology, painting and sculpture and the minor arts, examinations of core bibliographies, organizational patterns and problems, terminology and classification systems.

LBSC 753 Literature and Research in the Social Sciences. (3) Bibliographic organization, information structure and trends in the direction of research in the principal fields of the Social Sciences.

LBSC 756 Literature and Research in the Sciences. (3) Bibliographic organization, information structure and trends in the direction of research in the principal scientific disciplines.

LBSC 762 Medical Literature and Librarianship. (3) Introduction to medical literature and its reference sources, stressing those aspects of the field of medicine which lead to special characteristics in the organization and handling of its literature and innovations in medical librarianship and information services. Various kinds of Health Science library and information centers are discussed and biomedical library networks are

studied. Students will find it necessary to spend considerable time at the National Library of Medicine or another medical library.

LBSC 764 Legal Literature. (3) Survey and evaluation of information sources in law, with emphasis upon the bibliographic organization of the field.

LBSC 765 Library and Information Service Facilities-Objectives and Performance. (3) cr The aim of this course is to describe the context of demands and policies within which an ir or Library Service facility must operate.

LBSC 766 Business Information Services. (3) Survey and analysis of information sources in business, finance, and economics with emphasis upon their use in problem solving.

LBSC 767 Governmental Information Systems. (3) Analysis of the organization of the information structure and the publication and dissemination programs of the U.S. federal, state and municipal governments.

LBSC 770 Organization of Knowledge in Libraries II. (3) Conceptual problems in the organization of knowledge, specific cataloging and classification systems, rules of entry, application of the systems, choice of system to suit particular institutional and patron characteristics.

LBSC 772 Special Problems in the Organization of Knowledge. (3) Seminar course in which students may take topics of special interest to them in the area of organization of knowledge and explore them in a research project/class discussion format.

LBSC 774 Seminar in Linguistic Topics. (3) Basic notions of language and its effect on various aspects of Librarianship and Information Science. Emphasis on the problems of meaning and how language affects its users in communication situations; bibliographic aids to literature in foreign languages.

LBSC 775 Construction and Maintenance of Index Languages. (3) Treats the making of classification schedules, subject heading lists the overall system of information transfer. The information transfer process is discussed, as well as the fields of study concerned with that process. Use and user studies, models of communication and formal and informal communication channels, characteristics and behavior of the literative (bibliometrics), innovations in the communication system.

LBSC 781 Problems of Nonbook Materials. (3) Examination of nonbook materials such as audiorecords, motion pictures, maps, videorecords, machine-readable data files, and realia. Technical services applicable to nonbook materials.

LBSC 782 Seminar on Manuslpt Collections. (3) cr Analysis of the methods and philosophy of handling special papers and documentary material in a research library.

LBSC 783 Seminar in Technical Services. (3) Special issues in technical services in large libraries. Deals with such areas as acquisitions, cataloging, serial control, cooperative programs, and managerial controls.

LBSC 784 Resources of American Libraries. (3) Considers distribution and extent of library resources, means of surveying collections, mechanisms of interinstitutional cooperation in building collections, and means of developing research collections in special subject fields.

LBSC 785 Introduction to Reprography. (3) A survey of the processes and technology through which materials are made available in furthering library and information services, ranging from photography to microforms.

LBSC 790 Advanced Data Processing in Libraries. (3) Analysis of retrieval systems and intensive study of machine applications in the acquisition, analysis, coding, retrieval and display of information.

LBSC 792 Programming Systems for Information Handling Applications. (3) The elements of programming system design and operation are studied with special emphasis on the influence of information handling and library requirements.

LBSC 802 Seminar in Research Methods and Data Analysis. (3)

LBSC 899 Doctoral Dissertation Research. (1–8)

Marine-Estuarine-Environmental Sciences Program

Program Committee: Robert E. Menzer (ENTM), *Chairman;* Dale Bonar (ZOOL); Rita R. Colwell (MICB); Joseph Cooney (Chesapeake Biological Lab); George Heiz (CHEM); Frank Hetrick (MICB); Virgil Norton (AREC); Richard Pitter (METO); Stephen Sulkin (Horn Point Environmental Lab.); Shirley Van Valkenburg (BOTN).

The graduate program in Marine-Estuarine-Environmental Sciences (MEES) offers work leading to the M.S. (with thesis) and Ph.D. degrees and is designed to meet the needs of students who wish to pursue studies on the interactions of biological systems with physico-chemical systems. Appropriate areas of emphasis will involve organisms living in marine, estuarine, or terrestrial environments in their interactions with chemical and physical influences. Possible areas of specialization might include marine and estuarine ecology, environmental biology, environmental chemistry, environmental microbiology, environmental toxicology, environmental management, marine and environmental technology, and fisheries and wildlife management.

Admission and Degree Information

In addition to meeting the regular requirements of the Graduate School for admission, applicants are required to submit scores from the GRE Aptitude Test. Degree work may be pursued on a part-time basis.

The program is interdisciplinary, and the course of study will be tailored to the needs of the individual student as determined by that student's advisory committee. Course requirements and research credits are not in excess of general Graduate School requirements for the M.S. and Ph.D. There are several specific prerequisites, but these may be met through course work after the student is admitted to the graduate program. Statistics is required of all degree candidates. In addition, three (for the M.S.) or four (for the Ph.D.) courses, evenly chosen from five "core" areas, are required to provide essential background and breadth for any advanced work. The five broadly proposed "core" topic areas are 1) ecology and/or physiology of plants or animals; 2) ecology and/or physiology of microorganisms; 3) bio-chemistry; 4) physical, chemical, engineering, or geological sciences; and 5) management (economics, resource development, systems analyses, or biology and management of various natural resources).

Facilities and Special Resources

The facilities and faculty anywhere within the State-wide university system are avilable for use and involvement in the program. The degree candidate may take courses on any campus and may have an advisory committee composed of MEES participating faculty from several locations, including laboratory sites of the University's Center for Environmental and Estuarine Studies. Research problems may also be carried out where most appropriate, including the laboratories of CEES (Horn Point and Appalachian Laboratories, Chesapeake Biological Laboratory, and Marine Products Laboratory).

Campus facilities include well-equipped laboratories for research in most areas and terminal access to the University's UNIVAC 1106 and 1108 computers. Maryland has a very active Sea Grant research program, and students in marine work will have access to laboratory-equipped research vessels for work on the Chesapeake Bay and other waters.

In addition, students will find their work greatly enhanced by the special ties most faculty maintain to the many government laboratories and agencies in the Washington-Baltimore area. Library resources are among the best in the nation due to the proximity of the National Agricultural Library and the Library of Congress along with several other specialized libraries unique to this area.

Financial Assistance

Financial assistance in the form of teaching and research assistantships (through participating departments), as well as some fellowships, may be available to qualified candidates.

Additional Information

For additional information, contact:

Dr. Robert E. Menzer, Chairman, MEES Program, Office of the Graduate School, South Administration Bldg. University of Maryland, College Park

Courses

MEES 608 Seminar in Marine-Estuarine-Environmental Sciences (1–2)

MEES 631 Ecology of Estuarine Microbes I (5) Two lectures and one three-hour laboratory daily during Summer Session I. Prerequisite: Introductory course in each of Botany, Microbiology and Zoology, as well as Ecology, Physiology, and Systematics from one of the disciplines. Basic conceptual treatment of estuarine microbial interactions with emphasis on the algae, protozoa, bacteria and viruses of the Chesapeake Bay. The laboratory will stress observation and experimentation with collected material. Field and shipboard experience are included. Offered during Summer Session only.

MEES 632 Ecology of Estuarine Microbes II (5) Schedule by arrangement with instructor during summer session II. Prerequisite: MEES 631. Directed research on problems of estuarine microbial interactions.

MEES 681 Coastal Resource Use, Law and Management: The Chesapeake (3) An interdisciplinary course drawing on resource economics, political science and law to examine the natural resources of the Chesapeake and the market, political and legal processes through which Chesapeake resource use decisions result. The course is designed to provide social and natural scientists with an understanding of coastal use and management issues. No prerequisite.

MEES 698 Special Topics in Marine-Estuarine-Enviornmental Sciences (1–4) Credit according to time schedule and course organization. Lecture and/or laboratory series organized to study selected areas of environmental science not otherwise considered by existing courses. May be repeated for credit since topic coverage will change.

MEES 699 Special Problems in Marine-Estuarine-Environmental Sciences (1–3) Research on specialized topics under the direction of individual faculty members.

MEES 799 Masters Thesis Research. (1–6)

MEES 899 Doctoral Dissertation Research. (1–8)

Mathematical Statistics Program

Acting Director: Smith
Professors: Mikulski, Syski, Yang
Associate Professor: Smith
Assistant Professors: Kedem, Lee, Slud, Traxler, Wei

The Mathematical Statistics Program offers the degrees of Master of Arts and Doctor of Philosophy for graduate study and research in statistics. Areas of faculty research activity include

stochastic processes, potential theory, ergodic theory, statistical decision theory, biostatistics, stochastic modeling, nonparametric inference, analysis of variance, and time series analysis. Students may specialize in applied or theoretical statistics by selecting an appropriate sequence of courses and a research area to form an individual plan of study. The program has been designed with sufficient flexibility to accommodate the student's background and interest. Moreover, the Program offers students from other disciplines an opportunity to select a variety of statistics courses to supplement their own study.

The Program is administratively affiliated with the Department of Mathematics. In this arrangement the Department of Mathematics assumes the responsibility for the administration of the statistics courses under the STAT designation. Moreover, the Department maintains the records of all students in the Mathematical Statistics Program and handles correspondence with those applying for admission. However, it is important that any application for admission indicates clearly whether a student wishes to enter the Mathematics (MATH) or the Mathematical Statistics (STAT) Program.

Admission and Degree Information

In addition to the general requirements of the Graduate School, applicants for admission should have completed, with at least a B average (3.0 on a 4.0 scale), an undergraduate program of study which includes a strong emphasis on mathematics or statistics. Mathematical preparation at least through the level of advanced calculus will normally be considered sufficient demonstration of the expected mathematical background. In special cases students may be provisionally admitted without having fulfilled the general admission requirements, if there is evidence on the basis of other criteria of potential success in the Program. The Graduate Record Examination is not required for admission, but applicants for admission who have taken this examination are required to supply their score.

The M.A. degree can be earned by exercising either of two options. To earn an M.A. degree by the nonthesis option, a student must have 30 credit hours with an average of at least B and at least 18 of these credits must be at the graduate level (600/700 level). Of the required 30 credits, at least 12 of the graduate credits must be in statistics. The student must also pass the Mathematics Department written examination in probability, statistics and any third field of mathematics. The student has the choice of taking either the separate M.A. written examination or the Ph.D. written examination and being scored at a lower level. These examinations can be taken only twice except that any attempt during the first two years of graduate work is considered a "free try". The student must also submit a satisfactory scholarly paper.

To earn an M.A. degree by the thesis option, a student must have: a) 24 credit hours with at least 15 at the 600/700 level (of these 15 hours at least 12 hours must be in statistics); b) maintained an average grade of B or better; c) taken 6 hours of STAT 799 (Research) in addition to (a); d) written a satisfactory thesis; and e) passed a final oral examination.

There is no foreign language requirement for M.A. students.

The M.A. degree is not required for admission to the Ph.D. program. A student in the doctoral program must have a minimum of 36 hours of formal courses (at least 27 at the 600/700 level) with an average of B or better; at least 18 of the graduate credits must be taken in statistics. In addition, there is a University requirement of at least 12 hours of STAT 899 (Doctoral Research).

The Ph.D. aspirant must take a written examination in probability, statistics and any third field of mathematics. The written examination can be taken only twice except that, as in the case of the M.A. degree, any attempt during the first two years of graduate work is considered a "free try." The written examination is given by the Mathematics Department twice a year, in January and August.

If successful in this written examination, the student must pass an oral examination. The oral examination, given by the statistics faculty, usually takes place a year after the student passes the written examination. This examination serves as a test of the in-depth preparation of the student in the area of specialization and of his or her research potential. Successful completion of the oral exam indicates that the student is ready to begin writing his doctoral dissertation. In addition to the above, there is a requirement of reading competence in two foreign languages for the Ph.D. The student may select any two of the three languages: French, German, or Russian. The language examination, given and graded by the Mathematics Department, consists of translating foreign mathematical texts into competent English.

To be admitted to candidacy, the Ph.D. aspirant must pass the written examination, the oral examination and at least one of the two language examinations. The second language examination must be completed before the candidate's final oral examination on the dissertation.

Courses

STAT 400 Applied Probability and Statistics I. (3) Prerequisites: MATH 141 or 221. Random variables, standard distributions, moments, law of large numbers and central limit theorem. Sampling methods, estimation of parameters, testing of hypotheses.

STAT 401 Applied Probability and Statistics II. (3) Prerequisite: STAT 400. Point estimation—sufficient, unbiased, and consistent estimators. Interval estimation. Minimum variance and maximum likelihood estimators. Testing of hypotheses. Regression correlation and analysis of variance. Sampling distributions. Sequential tests, elements of non-parametric methods.

STAT 410 Introduction to Probability Theory. (3) Prerequisites: MATH 240 and MATH 241. Probability and its properties. Random variables and distribution functions in one and several dimensions. Moments. Characteristic functions. Limit theorems.

STAT 411 Introduction to Stochastic Processes. (3) Prerequisite: STAT 250 or 400 or equivalent. Elementary stochastic processes. Renewal process, random walks, branching process, discrete Markov chains, first passage times, Markov chains with a continuous parameter, birth and death processes. Stationary processes.

STAT 420 Introduction to Statistics. (3) Prerequisite: STAT 410 or equivalent. Point estimation, sufficiency, completeness, Cramer-Rao inequality, maximum likelihood. Confidence intervals for parameters of normal distribution. Hypotheses testing, most powerful tests, likelihood ratio tests. Chi-square tests, analysis of variance, regression, correlation. Nonparametric methods.

STAT 421 Elements of Statistical Inference (3) Prerequisite: STAT 420 or equivalent. Rank tests, confidence and tolerance intervals, Kolmogorov-Smirnov tests. Sequential analysis, multivariate analysis. Decision theory, Bayesian and Minimax procedures. Sampling theory.

STAT 440 Sampling Theory. (3) Prerequisite: STAT 401 or STAT 420, or consent of the instructor. Simple random sampling. Sampling for proportions. Estimation of sample size. Sampling with varying probabilities of sampling. Sampling: Stratified, systematic, cluster, double, sequential, incomplete.

STAT 450 Regression and Variance Analysis. (3) Prerequisite: STAT 401 or 420. One, two, three and four-way layouts in analysis of variance, fixed effects models, linear regression in several variables, Gauss-Markov-Theorem, multiple regression analysis, experimental designs.

STAT 460 Applied Nonparametric Statistics. (3) Prerequisite: A statistics course other than STAT 100. Review of basic statistical ideas. Sign tests and ranking methods for one and two samples, one-way layout, two-way layout, correlation and regression, including significance tests, nonparametric confidence intervals and robust point estimates. Goodness-of-fit, contingency tables, exact and Chi-square test for homogeneity and independence. Techniques illustrated using data from social biological and behavioral sciences.

STAT 464 Introduction to Biostatistics. (3) Prerequisite: One semester of calculus and junior standing. Probabilistic models. Sampling. Some applications of probability in genetics. Experimental designs. Estimation of effects of treatment. Comparative experiments. Fisher-Irwin test. Wilcoxon tests for paired comparisons. Not acceptable for credit towards degrees in Mathematics or Statistics.

STAT 498 Selected Topics in Statistics. (1–6) Prerequisite: Permission of the instructor. Topics of special interest to advanced undergraduate students will be offered occasionally under the general guidance of the MATH/STAT major committee. Students register for reading in statistics under this number. Repeatable to a maximum of 16 credits.

STAT 600 Probability Theory I. (3) Prerequisite: STAT 410 or MATH 400 with one semester of probability. Probability space, classes of events, construction of probability measures. Random variables, convergence theorems, images of measures. Independence. Expectation and moments, LeBesgue integration, LP spaces, Radon-Nikodym Theorem, singular and absolutely continuous measures. Conditional expectations, existence of regular distributions; applications. probabilities on product spaces, Fubini Theorem, Kolmogorov Extension Theorem, Tulcea Product Theorem.

STAT 601 Probability Theory II. (3) Prerequisite: STAT 600. Characteristic functions. Bochner's Representation Theorem. Helly's Theorems and Levy's Inversion Formula. Applications of Cauchy's Residue Theorem. Infinitely divisible distributions. Kolmogorov's Three-Series Theorem. Lab of the iterated logarithm. Arc Sine Law. Central Limit Theorems (Lindegerg-Feller Theorem). Weak and strong laws of large numbers. Martingale Convergence Theorems (for sequences).

STAT 610 Stochastic Processes I. (3) Prerequisite: STAT 601. Separability, measurability, and sample continuity of stochastic processes. Stopping times. Martingales: fundamental inequalities, convergence theorems and their applications, optional sampling, Riesz decomposition, sample function behavior. Processes with independent (orthogonal) increments, Brownian motion. Stationary processes, spectral analysis and Ergodic Theory.

STAT 611 Stochastic Processes II. (3) Prerequisite: STAT 601. Definition and classification of Markov processes. Properties of transition probabilities, forward and backward equations (boundary conditions), absorption probabilities, strong Markov-property, standard processes. Markovian semi-groups, extended infinitesimal operator. Sample function behavior. Connections between semigroup approach and sample function approach. Diffusion theory, ITO equation, potential theory, line topology.

STAT 650 Applied Stochastic Processes. (3) Prerequisite: STAT 410 or MATH 410 with one semester of probability. Basic concepts of stochastic processes. Renewal processes and random walks, fluctuation theory. Stationary processes, spectral analysis. Markov chains and processes (discrete andcontinuous parameters.) Birth and death processes, diffusion processes. Applications from theories of queueing, storage, inventory, epidemics, noise, prediction and others.

STAT 698 Selected Topics in Probability. (1–4) Prerequisite: Consent of instructor.

STAT 700 Mathematical Statistics I. (3) Prerequisite: STAT 410 or equivalent. Sampling distributions including noncentral Chi-square, T, F. Exponential families, completeness. Sufficiency, factorization, likelihood ratio. Decision Theory, Bayesian Methods, Minimax Principle. Point estimation. Lehmann-Scheffe and Cramer-Rao Theorems. Set estimation.

STAT 701 Mathematical Statistics II. (3) Prerequisite: STAT 700 or equivalent. Testing hypotheses-

parametric methods. Neyman-Pearson Lemma. Uniformly most powerful tests. Unbiased tests. Locally optimal tests. Nonparametric methods, Wilcoxon, Fisher-Yates, Median tests. Linear models, analysis of variance, regression and correlation. Sequential analysis.

STAT 710 Advanced Statistics I. (3) Prerequisite: STAT 421. Concurrent registration with STAT 600 recommended. Statistical decision theory. Neyman-Pearson Lemma and its extensions. Uniformly most powerful test. Monotone Likelihood Ratio. Exponential families of distributions, concepts of similiarity, and tests with Neyman Structure. Unbiased tests and applications to normal families.

STAT 711 Advanced Statistics II. (3) Prerequisite: STAT 710. Invariance, almost invariance, and applications to rank tests. Invariant set estimation. Linear models with applications to analysis of variance and regression. Elements of Asymptotic Theory. Minimax Principle and Hunt-Stein Theorem.

STAT 720 Nonparametric Statistics. (3) Prerequisite: STAT 421 or equivalent. Order statistics. Nonparametric point and set estimation. Tolerance regions. Invariance principle and its applications. Large sample properties and optimality criteria. Rank statistics, their distributions and moments. U statistics.

STAT 740 Analysis of Variance. (3) Prerequisite: STAT 700 or STAT 420. Linear models, point estimation, testing and confidence ellipsoids under normal theory. One-way layout, two-way layout and higher layouts. Topics in experimental design: Latin squares, analysis of covariance, factorial designs, random effects models, mixed models. Emphasis is placed upon the mathematical theory of the general linear models which contains regression analysis as a special case.

STAT 750 Multivariate Analysis. (3) Prerequisite: STAT 420 and MATH 400, or STAT 700. Multivariate normal, Wishart's and Hotelling's Distributions. Tests of hypotheses, estimation. Generalized distance, discriminant analysis. Regression and correlation. Multivariate analysis of variance; distribution of test criteria.

STAT 770 Analysis of Categorical Data. (3) Prerequisites: STAT 420, STAT 450 and some knowledge of Fortran; or consent of the instructor. Single classification, two-way classification; contingency tables; tests of homogeneity and independence models, measures of association, distribution theory. Bayesian methods. Incomplete contingency tables. Square contingency tables—symmetry. Extensions to higher dimesion, contingency tables.

STAT 798 Selected Topics in Statistics. (1–4) Prerequisite: Consent of instructor.

STAT 799 Master's Thesis Research. (1–6)

STAT 899 Doctoral Dissertation Research. (1–8)

Mathematics Program

Professor and Chairman: Kirwan
Professors: Adams, Alexander, Antman, Auslander, Babuska, Benedetto, Bernstein, Brace, Chu, Cohen, Cook, Correl, Douglis, Edmundson,[3] Ehrlich, Goldberg, Goldhaber, Goldstein, Good, Gray, Greenberg, Gulick, Heins, Horvath, Hubbard,[1] Hummel, Katok, Kellogg,[1] Kirwan, Kleppner, Lay, Lehner, Lipsman, Lopez-Escobar, Markley, Mikulski, Olver,[1] Osborn, Pearl, Reinhart, Syski, Vesentini, Wolfe, Yorke,[1] G. Yang, Zagier, Zalcman, Zedek
Associate Professors: Alexander, Berenstein, Berg, Cooper, Dancis, Ellis, Fey,[2] Fitzpatrick, Green, Helzer, Henkelman,[2] Johnson, Kueker, Liu, Neri, Neumann, Owings, Razar, Sather, Schafer, Schneider, Smith, Sweet, Warner, Winkelnkemper
Assistant Professors: Arnold, Brin, Brooks, Buchner, Chang, Currier, Herb, Kedem, King, Kudla, Traxler, Shanks, Slud, Washington, Wolpert, P. Yang.

[1]joint appointment with the Institute for Physical Science and Technology
[2]joint appointment with Secondary Education
[3]joint appointment with Computer Science

There are three programs that come under the cognizance of the Mathematics Department: the Mathematics Program proper (MATH), the Mathematical Statistics Program (STAT) and the Interdisciplinary Applied Mathematics Program (MAPL). Students applying for admission should indicate the program of interest to them by employing the appropriate symbol. The Statistics Program is concerned with mathematical statistics and probability. The interdisciplinary Applied Mathematics Program is described in detail elsewhere in this catalog but, as its name implies, is concerned with the interaction between mathematics and applied areas; it is directed by the Graduate Applied Mathematics Committee but administered by the Mathematics Department.

M.A. and Ph.D. degrees can be earned in each of these three programs. The Master's degree is not required for entrance to the Ph.D. Program.

The Department offers graduate programs in Algebra, Complex Analysis, Geometry, Mathematical Logic, Number Theory, Numerical Analysis, Ordinary Differential Equations, Partial Differential Equations, Probability, Real and Functional Analysis, Statistics, and Topology.

Admission and Degree Information

Admission is granted to applicants who show promise in mathematics as demonstrated by their collegiate mathematics record. Unless courses in Advanced Calculus and (undergraduate) Abstract Algebra have been taken admission may be on a provisional basis (passing MATH 410 and/or 403 with a grade of B). The Graduate Record Examination is not required for admission, but applicants for admission who have taken this examination are required to supply their score.

The M.A. degree can be earned by exercising either the thesis option (general University regulations prevail) or the non-thesis option but the great majority are choosing the latter. For this option a student must have 30 credit hours with an average of at least B of which at least 18 are at the 600/700 level, including at least 12 hours in mathematics. He must have completed two full-year sequences at the 600/700 level and he must have passed the Departmental written examinations in three mathematical fields.

The student has the choice of taking the separate M.A. battery of written examinations or taking the Ph.D. version and being scored at a lower level. These examinations can be taken only twice except that any attempt during the first two years of graduate work is considered a "free try."

There is no foreign language requirement for the M.A. degree.

It generally takes from two to three years to earn the M.A. Almost 25–30 are granted each year in mathematics (MATH, STAT, and MAPL combined).

The M.A. degree is not required for admission to the Ph.D. program but applicants who are accepted should show, on the basis of their undergraduate record and recommendations, that they possess not only marked promise in mathematical activities but the potential to perform on a creative level. Again, as in the M.A. case, admission may be granted on a provisional basis.

The departmental course requirements for the Ph.D. are a minimum of 36 hours of formal course work (at least 27 at the 600/700 level) with an average grade of B or better; at least 18 hours must be taken in the Department of Mathematics. In addition, there is a University requirement of at least 12 hours of MATH 899 (Doctoral Research).

The Ph.D. aspirant must take a set of three written examinations in three mathematical fields; these examinations can be taken any time except that an attempt during the first two years of graduate study constitutes a "free try." These examinations are given twice a year, in January and August. If successful in these written examinations, the student must satisfy the particular requirements of the field committee governing his special area of interest before he can be admitted to candidacy and engage in thesis research. The dissertation must represent an original contribution to mathematical knowledge and will usually be published in a mathematical journal.

The average Ph.D. aspirant will spend five years of graduate study before obtaining his degree. From 5 to 10 Ph.D.'s are awarded each year in the Department.

There are two foreign language requirements for the Ph.D. Before the aspirant can be admitted to candidacy he must pass a written examination in either French, German or Russian, translating mathematical texts into competent English. The second language examination must be completed before the candidate's final oral examination on the dissertation. Both language examinations are composed and graded within the Department.

Facilities and Special Resources

The Department is very strong in a number of areas, and the addition of the complement of mathematicians from the Institute for Physical Science and Technology adds further strength. There is a very active research atmosphere, and the Department fosters a lively program of seminars and colloquia of which about half are talks by outside specialists. Each year is devoted to a special mathematical field with a number of outside mathematicians in residence; the special year for 1979–1980 was in Smooth Ergodic Theory and the one for 1980–1981 will be in Numerical Analysis.

The Engineering and Physical Sciences Library is located on the ground floor of the Mathematics Building and contains more than 95,000 volumes in mathematics, physics, and engineering; more than 280 journals in pure and applied mathematics are received. The Library of Congress, with its extensive collection of books and technical reports, is only a half hour away from the campus.

The Department cooperates closely with the Institute for Physical Science and Technology and with the Department of Computer Science. Faculty members of both groups offer courses in the Department, and the facilities of the computer center are available to serve the research needs of both faculty and graduate students. Members of the Department participate actively in the interdisciplinary Applied Mathematics Program and staff the Mathematical Statistics Program.

Financial Assistance

The Department is able to offer graduate assistantships to approximately 110 graduate students. Generally these graduate assistants conduct recitation and quiz sections associated with a large lecture class taught by a faculty member. The teaching load is six hours each semester plus the attendant duties of meeting with students and grading papers. In addition graduate assistants are required to assist at registration time. There are a limited number of fellowships and research assistantships available. Study in Mathematics at the University of

Maryland"; "Departmental Policies Concerning Graduate Students"; Graduate Study in Applied Mathematics"; "Graduate Course Descriptions."

Dr. Daniel M. Dribin is the Executive of the Graduate Committee of the Department and he can be contacted regarding departmental programs, admission procedures and financial aid. Call 454–4900.

Courses

MATH 400 Vectors and Matrices. (3) Prerequisite: MATH 141 or 221. Algebra of vector spaces and matrices. Recommended for students interested in the applications of mathematics. (Not open to students who have had MATH 240 or 405).

MATH 401 Applications of Linear Algebra. (3) Prerequisite: MATH 400, or MATH 240, or consent of instructor. Various applications of linear algebra: theory of finite games, linear programming, matrix methods as applied to finite Markov chains, random walk, incidence matrices, graphs and directed graphs, networks, transportation problems.

MATH 402 Algebraic Structures. (3) Prerequisite: MATH 240 or equivalent. For students having only limited experience with rigorous mathematical proofs, and parallels MATH 403. Students planning graduate work in Mathematics should take MATH 403. Groups, rings, integral domains and fields, detailed study of several groups; properties of integers and polynomials. Emphasis is on the origin of the mathematical ideas studied and the logical structure of the subject. Not open to Mathematics graduate students. Credit will be given for only one of the courses, MATH 402 or MATH 403.)

MATH 403 Introduction to Abstract Algebra. (3) Prerequisites: MATH 240 and MATH 241 or equivalent. Integers, groups, rings, integral domains, fields. (Credit will be given for only one of the courses, MATH 402 or MATH 403.)

MATH 404 Field Theory. (3) Prerequisite: MATH 403. Algebraic and transcendental elements, Galois Theory, constructions with straight-edge and compass, solutions of equations of low degrees, insolubility of the quintic, Sylow Theorems, fundamental theorem of finite Abelian groups.

MATH 405 Introduction to Linear Algebra. (3) Prerequisites: MATH 240 and MATH 403 or consent of instructor. An abstract treatment of finite dimensional vector spaces. Linear transformations and their invariants. (Credit will be given for only one of the courses, MATH 400 or MATH 405.)

MATH 406 Introduction to Number Theory. (3) Prerequisite: MATH 141, or MATH 221 or consent of instructor. Rational integers, divisibility, prime numbers, modules and linear forms, unique factorization theorem, Euler's Function, Mobius' Function, cyclotomic polynomial, congruences and quadratic residues, Legendre's and Jacobi's Symbol, reciprocity law of quadratic residues, introductory explanation of the method of algebraic number theory.

MATH 410 Advanced Calculus. (3) Prerequisites: MATH 240 and MATH 241. First semester of a year course. Subjects covered during the year are: sequences and series of numbers, continuity and differentiability of real valued functions of one variable, the Rieman Integral, sequences of functions, and power series. Functions of several variables including partial derivatives, multiple integrals, line and surface integrals. The implicit function theorem.

MATH 411 Advanced Calculus. (3) Prerequisite: MATH 410, and MATH 240 or MATH 400. Continuation of MATH 410.

MATH 413 Introduction to Complex Variables. (3) Prerequisite: MATH 410. The algebra of complex numbers, analytic functions mapping properties of the elementary functions. Cauchy's Theorem and the Cauchy Integral Formula. Residues. (Credit will be given for only one of the courses MATH 413 or MATH 463.)

MATH 414 Differential Equations. (3) Prerequisite: MATH 240 and MATH 410, or equivalent. Existence and uniqueness theorems for initial value problems. Linear theory: fundamental matrix solutions, variation of constants formula, Floquet Theory for periodic linear systems. Asymptotic orbital and Lyapunov Stability with phase plane diagrams. Boundary value theory and series solutions are optional topics.

MATH 415 Introduction to Partial Differential Equations. (3) Prerequisites: MATH 246, and MATH 411 or MATH 251. (MATH 411 and MATH 415 may be taken concurrently). First order equations, linear second order equations in two variables, one dimensional wave equation and the method of separation of variables, and other topics such as harmonic functions, the heat equation, and the wave equation in space. (Credit will be given for only one of the courses MATH 415 or MATH 462.)

MATH 416 Introduction to Real Variables. (3) Prerequisite: MATH 410. The Lebesgue Integral. Fubini's Theorem. The LP spaces. Convergence theorems.

MATH 417 Introduction to Fourier Analysis. (3) Prerequisite: MATH 410. Fourier series. Fourier and LaPlace Transforms.

MATH 430 Geometric Transformations. (3) Prerequisite: MATH 240. Recommended for students in Mathematics Education. Important groups of geometric transformations, including the isometries and similarities of the plane. Geometries related to transformation groups.

MATH 431 Foundations of Geometry. (3) Prerequisite: One year of college Mathematics. Recommended for students in Mathematics Education. The axiomatic foundations of geometry. Attention will be given to one or more axiomatic developments of Euclidean Geometry and to the relation of Euclidean Geometry to other geometric systems.

MATH 432 Introduction to Point Set Topology. (3) Prerequisite: MATH 410 or 450, or equivalent. Connectedness, compactness, transformations, homomorphisms; application of these concepts to various spaces, with particular attention to the Euclidean Plane.

MATH 433 Introduction to Algebraic Topology. (3) Prerequisite: MATH 403 and 432, or equivalent. Chains, cycles, homology groups for surfaces, the fundamental group.

MATH 436 Introduction to Differential Geometry. (3) Prerequisites: MATH 241, and either MATH 240 or MATH 400, or equivalent. The differential geometry of curves and surfaces, curvature and torsion, moving frames, the fundamental differential forms, intrinsic geometry of a surface.

MATH 444 Elementary Logic and Algorithms. (3) Prerequisite: MATH 240 or consent of instructor. An elementary development of propositional logic, predicate logic, set algebra, and Boolean Algebra, with a discussion of Markov Algorithms, turing machines and recursive functions. Topics include post productions, word problems, and formal languages. (Also listed as CMSC 450).

MATH 446 Axiomatic Set Theory. (3) Prerequisite: MATH 403 or 450 or consent of instructor. Development of a system of axiomatic set theory, choice principles, induction principles, ordinal arithmetic including discussion of cancellation laws, divisibility, canonical expansions, cardinal arithmetic including connections with the axiom of choice, Hartog's Theorem, Konig's Theorem, properties of regular, singular, and inaccessible cardinals.

MATH 447 Introduction to Mathematical Logic. (3) Prerequisite: MATH 403 or 410 or 450. Formal propositional logic, completeness, independence, decidability of the system, formal quantificational logic, first-order axiomatic theories, extended Godel Completeness Theorem, Lowenheim-Skolem Theorem, model-theoretical applications.

MATH 450 Fundamental Concepts of Mathematics. (3) Prerequisite: MATH 240 or consent of instructor. Sets, relations, mappings. Construction of the real number system starting with Peano Postulates; algebraic structures associated with the construction; Archimedean Order, sequential completeness and equivalent properties of ordered fields. Finite and infinite sets, denumberable and non-denumberable sets.

MATH 461 Linear Algebra for Scientists and Engineers. (3) Prerequisites: MATH 141 and one MATH/STAT course for which math 141 is a prerequisite. Basic concepts of linear algebra. This course is similar to MATH 240, but with more extensive coverage of the topics needed in applied linear algebra: change of basis, complex eigenvalues, diagonalization, the Jordan Canonical Form. Credit will be given for only one of MATH 240, MATH 400 or MATH 461.

MATH 462 Linear Analysis for Scientists and Engineers. (3) Prerequisites: MATH 241 and some knowledge of differential equations. Linear spaces and operators, orthogonality, Sturm-Liouville Problems and eigenfunction expansions for ordinary differential equations, introduction to partial differential equations, boundary and initial value problems. (Credit will be given for only one course, MATH 462 or MATH 415.)

MATH 463 Complex Variables for Scientists and Engineers. (3) Prerequisite: MATH 241 or equivalent. The algebra of complex numbers, analytic functions, mapping properties of the elementary functions. Cauchy Integral Formula. Theory of residues and application to evaluation of integrals. Conformal mapping. (Credit will be given for only one of the courses, MATH 413 or MATH 463.)

MATH 464 Transform Methods for Scientists and Engineers. (3) Prerequisites: MATH 246, and either MATH 463 or MATH 413. Fourier series, Fourier and LaPlace Transforms. Evaluation of the complex inversion integral by the theory of residues. Applications to ordinary and partial differential equations of mathematical physics: solutions using transforms and separation of variables. Additional topics such as Bessel Functions and calculus of variations may be included.

MATH 472 Differential Equations and Numerical Methods. (3) Prerequisites: MATH 240, MATH 410, and CMSC 110 or their equivalents. A general introduction to the theory of ordinary differential equations emphasizing numerical methods for constructing approximate solutions. Existence and uniqueness theorems, Runge-Kutta Method, systems of linear differential equations, phase plane methods, and numerical solution of boundary value problems.

MATH 474 Applied Linear Algebra. (3) Prerequisites: MATH 240, MATH 241, and CMSC 110 or their equivalents. A treatment of finite dimensional linear spaces and linear transformations with an emphasis on applications and computational aspects.

MATH 475 Combinatorics and Graph Theory. (3) Prerequisite: MATH 240 and MATH 241. General enumeration methods, difference equations, generating functions. Elements of graph theory, matrix representations of graphs, applications of graph theory to transport networks, matching theory and graphical algorithms. (Also listed as CMSC 475.)

MATH 478 Selected Topics for Teachers of Mathematics. (1–3) Prerequisite: One year of college Mathematics or consent of instructor. This course cannot be used toward the upper level math requirements for MATH/STAT majors.)

MATH 481 Introduction to Number Theory. (3) Prerequisite: One year of college Mathematics or consent of instructor. Elementary number theory and the development of the real numbers for teachers. (Not open to students majoring in Mathematics or Physical Sciences.)

MATH 482 Introduction to Algebra. (3) Prerequisite: One year of college Mathematics or consent of instructor. Modern ideas in algebra and the theory of equations for teachers. (Not open to students majoring in Mathematics or Physical Sciences.)

MATH 483 Introduction to Geometry. (3) Prerequisite: One year of college Mathematics or consent of instructor. A study of basic ideas from Euclidean and non-Euclidean geometry for teachers. (Not open to students majoring in Mathematics or Physical Sciences.)

MATH 484 Introduction to Analysis. (3) Prerequisite: One year of college Mathematics or consent of instructor. A study of the limit concept and the calculus for teachers. Previous knowledge of calculus is not required. (Not open to students majoring in Mathematics or Physical Sciences.)

MATH 488 National Science Foundation Summer Institute for Teachers of Science and Mathematics—Seminar. (1–3) Lectures and discussion to deepen the student's appreciation of mathematics as a logical discipline and as a medium of expression. Special emphasis on topics relevant to current mathematical curriculum studies and revision. Not open to students majoring in Mathematics; not recommended for students majoring in any of the Physical Sciences.)

MATH 490 History of Mathematics. (3) Prerequisite: MATH 240 and 241, or equivalent. The development of Mathematics from around 1900 B.C. to around 1900 A.D. with special emphasis on the period of the Greeks (600 B.C.—200 A.D.), the period of development of the calculus (17th century), and the period of the institution

of the 'Modern' style of Rigor (19th century). Including the influence of the cultural environment on the development of mathematics at various times, the development of the mathematical concept of infinity and the limit process, the interplay between algebra and analysis, and the development of the modern concept of the mathematical proof.

MATH 498 Selected Topics in Mathematics. (3) Prerequisite: Permission of the instructor. Topics of special interest to advanced undergraduate students will be offered occasionally under the general guidance of the departmental committee on undergraduate studies. Honors students register for reading courses under this number.

MATH 600 Abstract Algebra I. (3) Prerequisite: MATH 405 or equivalent. Groups with operators, homomorphism and isomorphism theorems, normal series, Sylow Theorems, free groups, Abelian groups, rings, integral domains, fields, modules. If time permits, HOM (A, B), tensor products, extenor algebra.

MATH 601 Abstract Algebra II. (3) Prerequisite: MATH 600 or consent of instructor Field theory, Galois theory, multilinear algebra. Further topics from: Dedekind domains, Noetherian domains, rings with minimum condition, homological Algebra.

MATH 602 Homological Algebra. (3) Prerequisite: MATH 600. Projective and injective modules, homological dimensions, derived functors, spectral sequence of a composite functor. Applications.

MATH 603 Commutative Algebra. (3) Prerequisite: MATH 600. Ideal theory of Noetherian Rings, valuations, localizations, complete local rings, Dedekind domains.

MATH 604 Ring Theory. (3) Prerequisite: MATH 601 or consent of instructor. Topics selected from the following: ideal theory, structure theory of rings with or without minimum condition, division rings, algebras, non-associative rings.

MATH 605 Group Theory. (3) Prerequisite: MATH 601 or consent of instructor. Topics selected from the following: finite groups, Abelian groups, free groups, solvable or nipotent groups, groups with operators, groups with local properties, groups with clan conditions, extensions.

MATH 606 Algebraic Geometry I. (3) Prerequisite: MATH 600–601 or consent of instructor. Prime and primary ideals in Noetherian Rings, Hilbert Nullstellensatz places and valuations, prevarieties (in the sense of Serre), dimension, morphisms, singularities, varieties, schemes, rationality.

MATH 607 Algebraic Geometry II. (3) Prerequisite: MATH 606. Topics in contemporary algebraic geometry chosen from among: theory of algebraic curves and surfaces, elliptic curves, Abelian varieties, theory of schemes, theory of Zeta functions, formal cohomology, algebraic groups, reduction theory.

MATH 608 Selected Topics in Algebra. (3) Prerequisite: Consent of instructor.

MATH 620 Algebraic Number Theory I. (3) Prerequisites: MATH 601, or consent of instructor. Algebraic numbers and algebraic integers, algebraic number fields of finite degree, ideals and units, fundamental theorem of algebraic number theory, theory of residue classes, Minkowski's Theorem on linear forms, class numbers, Dirichlet's Theorem on units, relative algebraic number fields, decomposition group, inertia group and ramification group of prime ideals with respect to a relatively Galois extension.

MATH 621 Algebraic Number Theory II. (3) Prerequisites: MATH 600, 620 or equivalent. Valuation of a field, algebraic function fields, completion of a valuation field, ramification exponent and residue class degree, ramification theory, elements, differents, discriminants, product formula and charactenzation of fields by the formula, Gauss Sum, class number formula of cyclotomic fields.

MATH 630 Real Analysis I. (3) Prerequisite: MATH 411 or equivalent. Elementary set theory, elementary topological notions (especially for Euclidean space), Lebesgue measure and the Lebesgue integral on N, differentiation and integration of functions, absolute continuity, metric spaces, completeness and the Baire Category Theorem, LP spaces over N.

MATH 631 Real Analysis II. (3) Prerequisite: MATH 630. Locally compact Hausdorff spaces, Stone-Weierstrass theorem, general measure theory, Radon-Nikodym Theorem, Riesz Representation Theorem, introduction to Banach and Hilbert spaces, Hahn-Banach Theorem, closed graph theorem, Alaoglu's Theorem.

MATH 632 Functional Analysis I. (3) Prerequisite: MATH 631. Introduction to linear functional analysis and operator theory, normed linear spaces, spectral theory of bounded and unbounded self-adjoint operators, applications to differential equations, notions of duality and convexity, additional topics as time permits, e.g. locally convex spaces, distribution theory, perturbation theory. Note: MATH 632 and 633 are independent of one another and can be taken simultaneously.

MATH 633 Functional Analysis II. (3) Prerequisite: MATH 631. Introduction to abstract harmonic analysis, theory of Banach algebras, maximal ideal space, Gelfand-Naimark Theorem, locally compact groups, Fourier analysis on Abelian groups, Peter-Weyl Theorem, group representations, additional topics as time permits, e.g. function algebras, C*-algebras, spectral synthesis, transformation groups. Note: MATH 632 and 633 are independent of one another and can be taken simultaneously.

MATH 634 Linear Spaces I. (3) Prerequisite: MATH 632. Linear topological spaces, locally convex spaces, inductive limits, duality theory, Baire Spaces, barreled spaces, uniform boundedness principle, closed graph and open mapping theorems on Frechet Spaces, distributions.

MATH 635 Linear Spaces II. (3) Prerequisite: MATH 634. Topological tensor products, nuclear spaces and mappings, general closed graph theorems.

MATH 636 Banach Algebras. (3) Prerequisite: MATH 632. The Gelfand Representation: involution algebras, commutative and non-commutative representation theorems of Gelfand-Neumark; applications to spectral theory and abstract harmonic analysis.

MATH 640 Topological Groups I. (3) Prerequisite: MATH 630 and 631 or 730, or consent of instructor. General nature of toplogical groups including homomorphism theorems, Haar Measure, representations of compact groups and the Peter-Weyl Theorem. Pontrjagin Duality, Tanaka Duality and the Plancherel Theorem.

MATH 641 Topological Groups II. (3) Prerequisite: MATH 640, or equivalent. The concept of lie groups, the structure of compact groups, relations between lie groups and lie algebras, the structure of compact lie groups. Transformation groups.

MATH 648 Selected Topics in Analysis. (3) Prerequisite: Consent of instructor.

MATH 654 Non-Linear Elasticity. (3) Prerequisite: MATH 690. Fundamentals of Non-linear elasticity. Finite deformations, rubber elasticity, small deformations super-imposed on finite deformations.

MATH 655 Asymptotic Analysis and Special Functions I. (3) Prerequisite: MATH 413 or MATH 463. Transcendental Equations, Gamma Function, orthogonal polynomials, Bessel Functions, integral transforms, Watson's Lemma, LaPlace's Method, stationary phase, analytic theory of ordinary differential equations, Liouville-Green (or WKBJ) Approximation. Cross-listed with MAPL 655.)

MATH 656 Asymptotic Analysis and Special Functions II. (3) Prerequisite: MATH/MAPL 655. Steepest descents, coalescing Saddll-Points, singular integral equations, irregular singularities, Bessel, hypergeometic, and Legendre Functions, Euler-MacLaunn Formula, Darboux's Method, turning points, phase shift. Cross-listed with MAPL 656)

MATH 660 Complex Analysis I. (3) Prerequisite: MATH 410 or equivalent. Linear transformations, analytic functions, conformal mappings, Cauchy's Theorem and applications, power series, partial fractions and factorization, elementary Riemann Surfaces, Riemann's Mapping Theorem.

MATH 661 Complex Analysis II. (3) Prerequisites: MATH 630, 660. Topics in conformal mappings, normal families, Picard's Theorem, classes of univalent functions, extremal properties, variational methods, elliptic functions, Riemann Surfaces.

MATH 664 Interpolation and Approximation—Complex Domain. (3) Prerequisite: MATH 660 or consent of instructor. Possibility of approximation by polynomials. Lemniscates. Interpolation by polynomials. Maximal convergence. Uniform distribution of points. Interpolation and approximation by rational functions. Rational functions with some free poles.

MATH 665 Interpolation and Approximation—Real Functions. (3) Interpolation of real functions and remainder theory. Uniform and least square approximations. Chebychev oscillation theorems. Orthogonal polynomials. Degree of approximation. Abstract formulation of approximation theory. Constructive function theory

MATH 668 Selected Topics in Complex Analysis. (3) Prerequisite, Consent of instructor. Material selected to suit interests and background of the students. Typical courses: Riemann Surfaces, automorphic functions, several complex variables, symmetric spaces.

MATH 670 Ordinary Differential Equations I. (3) Prerequisites: MATH 405 and 410 or the equivalent. Existence and uniqueness, linear systems usually with Floquet Theory for periodic systems, linearization and stability, planar systems usually with Poincare-Bendixson Theorem. (Same as MAPL 670.)

MATH 671 Ordinary Differential Equations II. (3) Prerequisite: MATH 630 and MATH/MAPL 670 or the equivalent. The content of this course varies with the interests of the instructor and the class. Stability theory, control, time delay systems, Hamiltonian Systems, Bifurcation Theory, and boundary value problems, and the like. (Same as MAPL 671.)

MATH 673 Classical Methods in Partial Differential Equations I. (3) Prerequisite: MATH 410 or equivalent. Cauchy Problem for the wave equation and heat equation, Dirichlet and Neumann Problem for LaPlace's Equation. Classification of equations, Cauch-Kowaleski Theorem. General second order linear and nonlinear elliptic and parabolic equations. (Same as MAPL 673.)

MATH 674 Classical Methods in Partial Differential Equations II. (3) Prerequisite: MATH 673. General theory of first order partial differential equations, characteristics, complete integrals, Hamilton-Jacobi Theory, Hyperbolic systems in two independent variables, existence and uniqueness, shock waves, applications to compressible flow. (Same as MAPL 674.)

MATH 680 Eigenvalue and Boundary Value Problems I. (3) Prerequisites: MATH 405 and 410 or equivalent. Operational methods applied to ordinary differential equations. Introduction to linear spaces, compact operators in Hilbert Space, study of eigenvalues (Same as MAPL 680.)

MATH 681 Eigenvalue and Boundary Value Problems II. (3) Prerequisite: MATH/MAPL 680. Boundary value problems for linear Prequisite:MATH MAPL 680. Boundary value problems for linear partial differential equations. Method of energy integrals applied to LaPlace's equation, heat equations and the wave equations. Study of eigenvalues. (Same as MAPL 681.)

MATH 682 Variational Methods. (3) Prerequisite: Consent of instructor. The Euler-LaGrange Equation, minimal principles in mathematical physics, estimation of capacity, torsional rigidity and other physical quantities; symmetrization, isopenmetric inequalities, estimation of eigenvalues, the minimax principle.

MATH 685 Modern Methods in Partial Differential Equations I. (3) Prerequisite: MATH 630 and 631. Spaces of distributions, Fourier transforms, concept of weak and strong solutions. Existence, uniqueness and regularity theory for elliptic and parabolic problems, methods of functional analysis. (Same as MAPL 685.)

MATH 686 Modern Methods in Partial Differential Equations II. (3) Prerequisite: MATH/MAPL 685. Emphasis on non-linear problems, Sobolev Embedding Theorems, methods of monotonicity compactness, applications to elliptic, parabolic and hyperbolic problems. (Also listed as MAPL 686.)

MATH 699 Proseminar in Research. (1) Prerequisite: One semester of graduate work in Mathematics. Devoted to the foundations of mathematics, including mathematical logic, axiom systems, and set theory.

MATH 710 Consistency Proofs in Set Theory. (3) Prerequisites: MATH 446 and 447. Consistency and independence of such fundamental principles of set theory as the laws of choice, of cardinal arithmetic of constructability and regularity. Godel's Model of Constructible Sets, inner models, Cohen's Generic Models.

MATH 712 Mathematical Logic I (3) Prerequisite: Consent of instructor. Sentential logic, first-order languages, models and formal deductions. Basic model theory including completeness and compactness the-

orems, other methods of constructing models, and applocations such as non-standard analysis.

MATH 713 Mathematical Logic II. (3) Prerequisite: MATH 712 or 447. Incompleteness and undecidability results of Godel, Church, Tarski and others. Recursive function. Basic proof theory and axiomatic set theory.

MATH 715 Model Theory. (3) Prerequisite: MATH 712. Topics to be covered include the compactness theorem and Lowenheim-Skolem Theorems for first-order logic. 'Omega'-completeness theorem, ultra products, saturated and special models, definability results, categoricity in power, omitting types of elements, and applications to algebra and analysis.

MATH 716 Recursive Function Theory. (3) Prerequisite: MATH 713. Topics to be covered are formal definitions of computability and recursive functions, Kleenes' Enumeration and Fixed-Point Theorems, turing reducibility, the arithmetical hierarchy. Other topics are simple and hypersimple sets, truth-table reducibility, creative sets, Myhill's Theorem in one-one reducibility, deficiency sets, Friedberg's Solution of Post's Problem, maximal sets, retraceable sets, major subsets, the analytical hierarchy, recursive ordinals, hyper arithmetical sets.

MATH 718 Selected Topics in Mathematical Logic. (3) Prerequisite: Consent of instructor.

MATH 730 Topology and Manifolds I. (3) Prerequisites: MATH 410, 411, 403 or equivalents. Point set topology; fundamental group and covering spaces; introductory material on differentiable manifolds.

MATH 731 Topology and Manifolds II. (3) Prerequisite: MATH 730. Simplicial complexes; differential forms, homology theory and De Rham Theorem; classification of two manifolds.

MATH 734 Algebraic Topology I. (3) Prerequisite: MATH 731. Singular homology, uniqueness theorems, tensor products and homomorphisms, the functors Ext and Tor. Universal coefficient theorems, Kunneth and Eilenberg-Zilber Theorems, products and duality.

MATH 735 Algebraic Topology II. (3) Prerequisite: MATH 734. Higher homotopy groups, CW complexes, obstruction theory, Eilenberg-Maclane Spaces, the Serre Spectral Sequences.

MATH 737 Topological Dynamics and Dynamical Systems. (3) Basic ideas in dynamical systems, such as minimal sets, limit sets, recursive properties, equicontinuous systems, and various kinds of extensions. In-depth treatment of a current area of research in dynamical systems such as, abstract theory; symbolic dynamics; flows on manifolds; the theory of Kryloff and Bogoliouboff; topological ergodicity, disjointness, weak mixing and entropy; axiom A systems; almost periodic functions and their generalizations; uniformly distributed sequences and number theoretic applications.

MATH 740 Riemannian Geometry I. (3) Prerequisite: MATH 730 or consent of instructor. Review of differentiable manifolds, Riemannian Metrics, the Cartan Structure Equations, connections, curvature, immersions of Riemannian Manifolds, the Schwarzschild Metric. Kahler manifolds.

MATH 741 Riemannian Geometry II. (3) Prerequisite: MATH 740 or consent of instructor. Geodesics and the calculus of variations, Myer's Theorem, Riemannian Geometry of Submersions, fiber bundles, Riemannian Geometry of Lie groups and homogeneous spaces, harmonic forms characteristic classes using De Rham's Theorem (as in MATH 731), the Gauss-Bonnet Formula.

MATH 742 Differential Topology I. (3) Basic techniques in topology of smooth manifolds. Sard's Theorem, immersions, submersion, Whitney Embedding Theorem, transversality, smooth vector bundles, applications.

MATH 743 Differential Topology II. (3) Prerequisite: MATH 742 or consent of instructor. Tubular neighbourhoods, intergration of vector fields, smooth approximation, isotopy, application.

MATH 744 Lie Groups I. (3) Prerequisites: MATH 403, 405, 411 and 432, their equivalents, or consent of instructor. An introduction to the fundamentals of Lie groups, including some material on groups of matrices and Lie algebras.

MATH 745 Lie Groups II. (3) Prerequisite: MATH 744, or consent of instructor. A continuation of Lie Groups I in which some of the following topics will be emphasized: solvable Lie groups, compact Lie groups, classifications of semi-simple Lie groups, representation theory, homogeneous spaces.

MATH 748 Selected Topics in Geometry and Topology. (3) Prerequisite: Consent of instructor.

MATH 799 Master's Thesis Research. (1–6)

MATH 899 Doctoral Dissertation Research. (1–8)

Measurement and Statistics Program

Professor and Chairman: Lissitz.
Professors: Dayton, Stunkard.
Associate Professors: Johnson, MacReady, Schafer, Sedlacek.
Assistant Professors: Bourgue, Coulson.

In the Department of Measurement and Statistics, programs are available at both the master's and doctoral levels for persons desiring a major in measurement and statistics, and program evaluation in education. In addition, a doctoral minor is offered for students majoring in other areas. Each of these programs is designed to integrate the three areas of research design, measurement and statistics.

Admission and Degree Information

The doctoral major program is primarily intended to produce individuals qualified to teach courses at the college level in educational research, program evaluation, measurement and statistics; conduct research studies in the field of education; advise in the conduct of research studies; and serve as measurement and evaluation specialists in school systems, industry and government. The master's level program is designed to produce qualified individuals to serve as junior statisticians in various fields and to provide qualified test administration, scoring, and interpretation services (both the thesis and non-thesis option are offered). Courses within the program are selected from offerings of the College of Education and other Departments of the University. A program for an individual student is planned to take into account his own background and future aims. About half the work within the major is elected to meet the needs and special interests of the individual student.

Facilities and Special Resources

Persons planning a college teaching career will have opportunities to engage in supervised activities appropriate for future faculty members whose specialization will be in these areas. Research experience utilizing modern electronic data processing equipment will be obtained.

Financial Assistance

Some Graduate Assistantships and other funds are available.

Additional Information

For information and a departmental brochure, please write to the Director of the Graduate Program.

Courses

EDMS 410 Principles of Testing and Evaluation. (3) Basic principles including the steps in the specification of instructional objectives and subsequent development of teacher-made tests; problems in the use and interpretation of achievement and aptitude tests; introduction to the development and use of non-testing evaluation procedures; basic consideration in the assignment of marks and grades; introduction to computer technology as applied to measurement.

EDMS 451 Introduction to Educational Statistics. (3) Designed as a first course in Statistics for students in Education. Emphasis is upon educational applications of descriptive statistics, including measures of central tendency, variability and association. Also included are inferential statistics through one-way Anova.

EDMS 465 Algorithmic Methods in Educational Research. (3) Introduction to the use of the computer as a tool in educational research. Instruction in a basic scientific computer source language as well as practical experience in program writing for solving statistical and educational research problems.

EDMS 489 Field Experiences in Measurement and Statistics. (1–3) Prerequisites: At least six credits in Education courses at the University of Maryland, plus such other prerequisites as may be set by the major area in which the experience is to be taken. Planned field experience for Education majors. Repeatable for credit to a maximum of six credits.

EDMS 498 Special Problems in Measurement and Statistics. (1–3) Prerequisite: Consent of instructor. Available only to Education majors who have formal plans for individual study of approved problems. Repeatable for credit to a maximum of six credits.

EDMS 622 Theory and Practice of Standardized Testing. (3) Prerequisite: EDMS 410, 446 or 451. Study of groups tests typically employed in school testing programs; discussion of evidence relating to the measurement of abilities; practice in standardized group test administrations.

EDMS 626 Measurement Techniques for Research. (3) Theory, development and applications of various measurement instruments and procedures used in educational research. Questionnaires, interviews, rating scales, attitude scales, observational procedures, ecological approaches, Q-sort, semantic-differental, sociometry and other approaches. Prerequisite: EDMS 451 or 646.

EDMS 645 Quantitative Research Methods I. (3) An introduction to research design principles and the scientific method as applied to behavioral phenomena. Instrumentation procedures including the planning and construction of simple data collection instruments and their analysis, and assessment of the reliability and validity of such instruments. Statistical procedures appropriate to the analysis of data from simple research designs. Laboratory experiences in instrumentation and research design are emphasized.

EDMS 646 Quantitative Research Methods II. (3) Prerequisite: EDMS 446. Special problems arising in the implementation of educational research designs. Instrumentation to measure attitudes and collection of questionnaire data. Additional statistical procedures appropriate to the analysis of education research designs. Laboratory experiences in instrumentation and research design are emphasized.

EDMS 647 Introduction to Evaluation Models. (3) Prerequisite: EDMS 646, or equivalent. Explores the principal approaches to evaluation research.

EDMS 651 Intermediate Statistics in Education. (3) Distributional theory; Chi-square analysis of contingency tables; analysis of variance; introduction to multiple correlation and regression.

EDMS 653 Correlation and Regression Analysis. (3) Prerequisite: EDMS 651. Systematic development of simple regression, multiple regression, and nonlinear regression as applied to educational research problems. Emphasis is on underlying theory of procedures and on analytical approaches which are amenable to computerization.

EDMS 723 Measurement Theory I. (3) Prerequisite: EDMS 410, 451, or 646. Classical measurement theory dealing with the nature of measurement, principles and procedures concerning the accuracy of measurement and prediction, reliability, and validity theory.

EDMS 724 Measurement Theory II. (3) Theoretical formulations of reliability, validity and scaling as related to problems in measurement theory and prediction. Prerequisites: EDMS 651, 723.

EDMS 726 Practicum in Individual Testing I. (3) Prerequisite: EDMS 622. The administration and interpretation of the Stanford-Binet and Wechsler scale of intelligence.

EDMS 727 Practicum in Individual Testing II. (3) Prerequisite: EDMS 622 or consent of the instructor. Provides practicum experience in the administration of and the interpretation of the results of individual psy-

chological tests. Designed to familiarize the student with alternate instruments to the Stanford-Binet and Wechsler scales of intelligence as will as to introduce the measurement of special abilities through the use of appropriate instruments.

EDMS 738 Seminar in Special Problems in Measurement. (1–3) Prerequisite: Consent of the instructor. An opportunity for students with special interests to focus in depth on contemporary topics in measurement. Topics to be announced, but will typically be related to applied and theoretical measurement.

EDMS 747 Design of Program Evaluations. (3) Prerequisites: EDMS 626, 647, and 651, or permission of instructor. Analysis of measurement and design problems in program evaluations.

EDMS 769 Special Topics in Applied Statistics in Education. (1–4) Prerequisite: EDMS 771 or equivalent, and consent of instructor. Designed primarily for students majoring or minoring in Measurement and Statistics in Education. Topics to be announced, but will typically relate to the areas of advanced multivariate analysis and advanced design of experiments.

EDMS 771 Design of Experiments. (3) Prerequisite: EDMS 651 or equivalent. Primarily for the Education student desiring more advanced work in statistical methodology. Survey of major types of statistical design in educational research; application of multivariate statistical techniques to educational problems.

EDMS 779 Seminar in Applied Statistics. (1–3) Enrollment restricted to doctoral students with a major or minor in Measurement and Statistics. Seminar topics will be chosen in terms of individual student interest.

EDMS 780 Research Methods and Materials. (3) Research methodology for case studies, surveys, and experiments; measurements and statistical techniques. Primarily for advanced students and doctoral candidates.

EDMS 798 Special Problems in Education. (1–6) Master's, AGS, or doctoral candidates who desire to pursue special research problems under the direction of their advisors may register for credit under this number.

EDMS 799 Master's Thesis Research. (1–6) cr Registration required to the extent of 6 hours for master's thesis.

EDMS 879 Doctoral Seminar. (1–3) Prerequisite: Passing the preliminary examinations for a doctor's degree in Education, or recommendation of a doctoral advisor. Analysis of doctoral projects and theses, and of other on-going research projects. A doctoral candidate may participate in the seminar during as many university sessions as he desires, but may earn no more than three semester hours of credit accumulated one hour at a time in the seminar. An Ed.D. candidate may earn in total no more than nine semester hours, and a Ph.D. candidate, no more than eighteen semester hours in the seminar and in EDMS 899.

EDMS 889 Internship in Measurement and Statistics. (3–16) Internships in the major area of study are available to selected students who have teaching experience. The following groups of students are eligible: (a) Any student who has been advanced to candidacy for the doctor's degree; and (b) Any student who receives special approval by the Education faculty for an internship provided that prior to taking an internship, such student shall have completed at least 60 semester hours of graduate work, including at least six semester hours in Education at the University of Maryland. Each intern is assigned to work on a full-time basis for at least a semester with an appropriate staff member in a cooperating school, school system, or educational institution or agency. The internship must be taken in a school situation different from the one where the student is regularly employed. The intern's sponsor maintains a close working relationship with the intern and the other persons involved. Note: The total number of credits which a student may earn in EDMS 489, 888, and 889 is limited to a maximum of twenty (20) semester hours.

EDMS 899 Doctoral Dissertation Research. (1–8) Registration required to the extent of 6–9 hours for an Ed.D. project and 12–18 hours for a Ph.D. dissertation.

Mechanical Engineering Program

Professor and Chairman: Cunniff
Professors: Allen, Anand, Armstrong, Berger, Buckley, Dieter, Fourney, Hsu, Irwin, Marcinkowski, Marks, Sallet, Sayre, Shreeve, Talaat, Wockenfuss, Yang.
Associate Professors: Hayleck, Holloway, Kirk, Kobayashi, Wallace, Walston.
Assistant Professors: Abdulhadi, Barker, Bernard,, Dagalakis, Metcalf, Shih, Tsui.
Lecturers: Baker, Coder, Dawson, Reed, Reid,

The Mechanical Engineering Department offers a broad based program leading to a Master of Science degree with courses drawn from four different areas of specialization: (1) Energy, (2) Fluid Mechanics, (3) Solid Mechanics and (4) Systems Analysis and Design. In certain cases, a student may wish to concentrate his studies early in his graduate work and M.S. programs in each of the four areas of specialty are available. For the Ph.D. program which stresses research capabilities, an area of specialization should be selected early so that the student can prepare for the comprehensive examination and can establish the depth of understanding in a given technical area necessary to begin thesis research.

(1) Energy. This area of specialization treats the transformation, transportation and utilization of all types of energy. The area encompasses four main topics that include solar energy, energy conversion, heat and mass transfer, and thermodynamics. Solar energy studies deal with the engineering applications of solar thermal energy to heating, cooling, and the generation of electricity with photovoltaic, biological and wind-power systems. Included in energy conversion coverage are thermoelectric, thermoionic, photovoltaic, fuel cells and magnetohydrodynamics. Analytical, empirical, and experimental solutions are developed in solving heat and mass transfer problems. The coverage in thermodynamics includes macroscopic and microscopic considerations of processes, statistical methods and irreversible processes.

(2) Fluid Mechanics. This area of specialization prepares the student for study in advanced analytical and experimental methods in fluid mechanics. Emphasis is placed on the development of methods and procedures with the application following an exposure to fundamental procedures. Areas of study include road vehicle aerodynamics, two phase flow, boundary layers and jets, vortex dynamics, shock wave phenomena, and ocean engineering. Laboratory facilities are available for research in low speed flow phenomena, two phase flow studies, vortex motions, and hydromechanics.

(3) Solid Mechanics. This area of specialization emphasizes exposure to fundamental concepts in analytical and experimental methods of solid mechanics. Areas of study include theoretical and applied elasticity, fracture mechanics, experimental mechanics, noise and vibration control, acoustics, numerical modeling, and linear and nonlinear mechanics. Laboratory facilities are available for research in stress analysis, fracture, acoustics, photoelasticity, and holography.

(4) Systems Analysis and Design. This area of specialization combines fields of science and technology for the purposes of analysis, synthesis, design and management of complex systems. In addition to traditional applications to communication, transportation and aerospace systems and production processes, this area of specialization finds increased application in economics, biomedical engineering and urban problems. The graduate program is organized to include a variety of courses in control systems, optimization design, systems analysis, and economics of product design and processing. Research programs often stress specific as well as interdisciplinary areas of investigation. Experimental research facilities are available for studies of polymer processes, control systems and tribology.

Admission and Degree Information

The programs leading to the M.S. and Ph.D degrees are open to qualified students holding the B.S. degree. Admission may be granted to students with degrees outside of mechanical engineering. In some cases it may be necessary to require undergraduate courses to complete the student's background. The general regulations of the Graduate School apply in reviewing applications.

The candidate for the M.S. degree has the choice between the thesis option or the nonthesis option. The equivalent of at least three years of full-time study beyond the B.S. degree is required for the Ph.D. degree. In addition to the general rules of the Graduate School, certain special degree requirements are set forth by the department in its departmental publications.

Facilities and Special Resources

The Department maintains laboratory facilities for graduate research. air guns, impact testers, vibration shaker tables, and acoustic analysis equipment are available for studies in dynamic stress analysis and vibration. Static and dynamic stress analysis are conducted by photoelastic and holographic techniques. The fluid dynamics facilities include wind tunnels, water tables, a shock tube, a high-vacuum apparatus, water turbines, and diagnostic equipment. Both a closed-loop magnetoplasma-dynamics facility and a solar energy laboratory are available for experimental research in the energy area. An analog computer, function generators, recorders, and plotters are utilized for experimental research in systems analysis. There is a large complement of mechanical testing equipment for research in engineering materials. The Institute for Physical Science and Technology maintains a fully-equipped electron microscopy facility, an X-ray diffraction facility and equipment for crystal growing. The engineering computational facility contains remote terminals to the University's UNIVAC 1106 and UNIVAC 1108 digital computers, which are used in support of research programs. The Engineering Library is housed nearby in conjunction with the mathematics and physical science collections.

Financial Assistance

Financial assistance is available to outstanding students in the form of teaching assistantships, research assistantships and instructorships

Additional Information

Additional information may be obtained from the Graduate Advisor, Department of Mechanical Engineering.

Courses

ENME 400 Machine Design. (3) Two lectures and one laboratory period a week. Prerequisite: ENME 300, 360. Working stresses, stress concentration. stress analysis and repeated loadings. Design of machine elements. Kinematics of mechanisms.

ENME 402 Selected Topics in Engineering Design. (3) Prerequisite: Senior standing in mechanical engineering or consent of instructor. Creativity and innovation in design. Generalized performance analysis, re-

liability and optimization as applied to the design of components and engineering systems. Use of computers in design. Design of multivariable systems.

ENME 403 Automatic Controls. (3) Prerequisites: ENEE 300, senior standing. Hydraulic, electrical, mechanical and pneumatic automatic control systems. Open and closed loops. Steady state and transient operation, stability criteria, linear and non-linear systems. LaPlace transforms.

ENME 404 Mechanical Engineeting Systems Design. (4) Two lectures and two laboratory periods per week. Prerequisite: Senior standing in mechanical engineering. Design of components that form a complete working system. Engineering economics, performance-cost studies, optimization. Engineering design practice through case studies. Legal and ethical responsibility of the designer. Not open to students who have credit in ENME 401.

ENME 405 Energy Conversion Design. (3) Two lectures and one laboratory per week. Prerequisite: Senior standing in mechanical engineering. Application of thermodynamics, fluid mechanics and heat transfer to energy conversion processes. Design of engines, compressors, heat exchangers. Energy storage and fuel handling equipment. Not open to students who have credit in ENME 421.

ENME 410 Operations Research I. (3) Prerequisite: Senior standing in mechanical engineering. Applications of linear programming, queuing model, theory of games and competitive models to engineering problems.

ENME 411 Introduction to Industrial Engineering. (3) Prerequisites: ENME 300 and ECON 205 or consent of instructor. This course is concerned with the design, improvement and installation of integrated systems of men, materials and equipment. Areas covered include industrial activities, plant layout and design, value analysis, engineering economics, quality and production control, methods engineering, industrial relations, etc.

ENME 412 Mechanical Design for Manufacturing and Production. (3) Prerequisite: Senior standing in engineering. The physical properities of materials. Review of key fundamental principles used in product design. Characterization of various classes of engineering materials. The types of manufacturing processes which can be applied to production of the design.

ENME 415 Engineeting Applications of Solar Energy. (3) Prerequisites: ENME 315 and 321. Collection, storage, and utilization of solar thermal energy. Conversion to electricity. Component and system modeling equations. Performance analysis. Systems design.

ENME 420 Energy Conversion. (3) Prerequisite: ENME 320. Chemical, heat, mechanical, nuclear and electrical energy conversion processes, cycles and systems. Direct conversion processes of fuel cells, thermionics and magneto hydromechanics.

ENME 422 Energy Conversion II. (3) Prerequisite: ENME 421. Advanced topics in energy conversion. Direct conversion processes of fuel cells, solar cells, thermionics, thermoelectrics and magnetohydrodynamics.

ENME 423 Environmental Engineering. (3) Prerequisite: ENME 321 and senior standing in Mechanical Engineering. Heating and cooling load computations. Thermodynamics of refrigeration. Low temperature refrigeration. Problems involving extremes of temperature, pressure, acceleration and radiation.

ENME 424 Themodynamics II. (3) cr Prerequisites: ENME 321, senior standing. Applications to special systems, change of phase, low temperature. Statistical concepts, equilibrium, heterogenous systems.

ENME 442 Fluid Mechanics II. (3) Prerequisite: ENME 342, senior standing. Hydrodynamics with engineering applications. Stream function and velocity potential, conformal transformations, pressure distributions, circulation, numerical methods and analogies.

ENME 450 Mechanical Engineering Analysis for the Oceanic Environment. (3) Prerequisite: Junior standing. Study of the characteristics of the marine environment which affect the design, operation and maintenance of mechanical equipment, effects of waves, currents, pressure, temperature, corrosion, and fouling. Study of design parameters for existing and proposed mechanical systems used in marine construction, on shipboard, in search and salvage operations.

ENME 451 Mechanical Engineering Systems for Underwater Operations. (3) Prerequisite: ENME 450 or consent of instructor. Study of propulsion, control and environmental systems for submerged vehicles. Design of mechanical systems in support of diving and saturated living operations.

ENME 452 Physical and Dynamical Oceanography. (3) Prerequisites: Consent of the instructor. Historical review of oceanography physical, chemical, stratification and circulation properties of the ocean; dynamics of frictionless, frictional, wind driven and thermohaline circulations; air-sea interactions.

ENME 453 Ocean Waves, Tides and Turbulences. (3) Prerequisite: METO 420 or consent of instructor. Introduction to the theory of oceanic wave motions, tides, wind waves, swells, storm surges, seiches, tsunamies, internal waves, turbulence, stirring, mixing and diffusion.

ENME 461 Dynamics II. (3) Prerequisites: ENME 360, differential equations, senior standing in Mechanical Engineering. Linear and non-linear plane and three-dimensional motion, moving axes, LaGrange's Equation, Hamilton's Principle, non-linear vibration, gyroscope, celestial mechanics.

ENME 462 Introduction to Engineering Acoustics. (3) Prerequisite: ENME 380 or equivalent. Study of the physical behavior of sound waves. Introduction to terminology and instrumentation used in acoustics. Criteria for noise and vibration control. Some fundamentals underlying noise control and applications to ventilation systems, machine and shop quieting, office buildings, jet noise, transportation systems and underwater sound.

ENME 463 Mechanical Engineering Analysis. (3) Three lectures a week. Prerequisite: ENME 380, or MATH 246. Mathematical modeling of physical situations. Solution of problems expressed by partial differential equations. Application of Fourier series and integrals, LaPlace Transformation, Bessel Functions, Legendre Polynominals and complex variables to the solution of engineering problems in mechanical vibrations, heat transfer, fluid mechanics and automatic control theory.

ENME 464 Machine Design II. (3) Prerequisite: ENME 400. The study of stress and strain as applied to engineering problems; stress and strain from a three dimensional point of view; theories of failure; residual stresses; dynamic loading; fatigue; environmental influence; temperature extremes; corrosive media. Case studies of design practices.

ENME 465 Introductory Fracture Mechanics. (3) Prerequisite: Senior standing in engineering. An examination of the concepts of fracture in members with preexisting flaws. Emphasis is primarily on the mechanics aspects with the development of the Griffith Theory and the introduction of the stress intensity factor, K, associated with different types of cracks. Fracture phenomena are introduced together with critical values of the fracture toughness of materials. Testing procedures for characterizing materials together with applications of fracture mechanics to design are treated.

ENME 480 Engineering Experimentation. (3) One lecture and two laboratory periods a week. Prerequisite: Senior standing in Mechanical Engineering. Theory of experimentation. Applications of the principles of measurement and instrumentation systems to laboratory experimentation. Experiments in fluid mechanics, solid mechanics and energy conversion. Selected experiments or assigned projects to emphasize planned procedure, analysis and communication of results, analogous systems and leadership.

ENME 481 Engineering Experimentation. (3) One lecture and two laboratory periods a week. Prerequisite: Senior standing in Mechanical Engineering. Theory of experimentation. Applications of the principles of measurement and instrumentation systems to laboratory experimentation. Experiments in fluid mechanics, solid mechanics and energy conversion. Selected experiments or assigned projects to emphasize planned procedure, analysis and communication of results, analogous systems and leadership.

ENME 488 Special Problems. (3) Prerequisite: Senior standing in Mechanical Engineering. Advanced problems in Mechanical Engineering with special emphasis on mathematical and experimental methods.

ENME 489 Special Topics in Mechanical Engineering. (3) Prerequisite: Permission of instructor. May be taken for repeated credit up to a total of 6 credits, with the permission of the student's advisor. Selected topics of current importance in Mechanical Engineering.

ENME 600 Advanced Mechanical Engineering Design. (3) Synthesis of stress analysis and properties and characteristics of materials as related to design. Areas covered: combined stress designs, optimizations, composite structures, stress concentrations, design under various environmental conditions, metal working, limit analysis, etc. Review of design literature, design project.

ENME 605 Systems Analysis I. (3) Prerequisite: ENME 403. Linear control systems using time and frequency techniques; classical and state space formation; graphical methods; stability and performance indices; controllability and observability. Examples from mechanical, fluid, thermal, as well as hybrid systems.

ENME 606 Systems Analysis II. (3) Prerequisite: ENME 605. Nonlinear systems using series and linearizing techniques; switching systems; classical and state space techniques; discrete systems and hybrid systems; systems using stochastic inputs, introduction to filtering and estimating

ENME 607 Systems Modeling and Simulation. (3) Prerequisite: MATH 462 or equivalent. Modeling of complex electromechanical, fluid, and thermal systems. Digital and analog computer simulation in the time and frequency domain for dynamic analysis. Modification of system characteristics to meet response requirements. Application to mechanical engineering systems.

ENME 610 Optimization Design for Mechanical Engineering. (3) Prerequisites: ENME 404 or MAPL 477. Analytical and computational techniques for solving optimization problems in mechanical engineering. Review of the basic parameter and functional optimization methods. Optimization problems from the fields of structural analysis, vibrations, mechanisms design, machine elements, biomedical engineering, and energy systems.

ENME 611 Economics of Product Design and Processing. (3) Prerequisite: ENME 300 or equivalent. Consideration of the costs of manufacturing processes in design. Characterization of manufacturing processes as basic (casting, forging, molding, etc.) or secondary (machining, cold working, drawing, etc.). Description of processes in terms of capabilities, costs and effects on mechanical properties of the product.

ENME 624 Energy Conversions—Plasma State. (3) Prerequisite: ENME 405. Theory, design and performance analysis of magnetoplasmadynamic (magnetohydrodynamic) and thermionic-plasma energy conversion, considering their compatible energy sources. Certain aspects of fusion plasma and fusion energy to electrical energy conversion.

ENME 630 Advanced Heat Transfer. (3) Prerequisites: ENME 315, 321, 342, 343. Theory of conduction, convection, and radiation. Physical properties and experimental methods. Equations of transfer and their solution. Network analysis and engineering methods.

ENME 631 Advanced Conduction and Radiation Heat Transfer. (3) Prerequisite: ENME 315, 321, and 700. Theory of conduction and radiation. Anisotropic conduction and bidirectional radiation properties and experiments. General conduction and radiation governing equations. Integration, finite-difference, and finite element techniques. Combined conduction and radiation. Engineering applications.

ENME 632 Advanced Convection Heat Transfer. (3) Prerequisite: ENME 315, 342, 343, and 700. Theory of convection and mass transfer in pipe flow, boundary layer flow, separated flow, free convection, boiling and condensing. Flow and energy equations. Solutions and engineering applications. Experimental methods.

ENME 633 Advanced Classical Thermodynamics. (3) Prerequisite: ENME 315. The laws of classical thermodynamics. Equations of state. Temperature scales. Availability. General equilibrium. Corollaries to the second law. Chemical thermodynamics.

ENME 634 Statistical and Irreversible Thermodynamics. (3) Prerequisite: ENME 315. Kinetic theory of gases and transport properties. Quantum mechanics and statistics. Partition functions and applications. Solids, liquids, and gases. Irreversible processes, coupled phenomena and applications.

ENME 635 Analysis of Energy Systems. (3) Prereq-uisites: ENME 403, 404, and 405. Energy conversion

systems for renewable and non-renewable energy sources. Component modeling, performance charts. Overall indices of performance. Environmental effects. Cost effectiveness. Optimization strategies. Case studies.

ENME 647 Multiphase Flow and Heat Transfer. (3) Prerequisites: ENME 321 and 342 or equivalent. Phase-change heat transfer phenomenology, analysis and correlations; boiling and condensation in stationary systems. Multiphase flow fundamentals; one-dimensional, two-phase flow analysis. Critical flow rates. Convective boiling and condensation. Two-phase flow instabilities. Applications.

ENME 650 Design of Turbomachinery. (3) Prerequisite: ENME 342 or equivalent. Characteristics and design of turbines, pumps, compressors and torque convertors, cavitation, stall and surge.

ENME 651 Fundamentals of Fluid Mechanics I. (3) Pre- or corequisite: ENME 700 or equivalent mathematical background. A broad study of the fundamental principles of fluid mechanics including potential flow, viscous flow and compressible flow.

ENME 652 Fundamentals of Fluid Mechanics II. (3) cr Prerequisite: ENME 651. A continuation of ENME 651.

ENME 653 Topics in Hydrodynamics. (3) Prerequisite: ENME 651 or equivalent. Analysis of the flow of fluids in which viscosity and compressibility are not significant. Complex variable techniques, method of images, small perturbation techniques, surface waves, thin airfoil theory, and geophysical flows.

ENME 654 Topics in Compressible Flow. (3) Prerequisite: ENME 652 or equivalent. Study of the compressible flow of fluids. Method of characteristics, experimental techniques, small perturbation theory and similarity rules, and gas dynamics of two-phase flows and reacting mixtures.

ENME 655 Topics in Viscous Flow. (3) Prerequisite: ENME 652 or equivalent. Current techniques in analysing viscous flows in engineering applications. Integral, and numerical methods, asymptotic methods, and their applications.

ENME 658 Current Topics in Fluid Dynamics. (3) cr May be repeated for credit to maximum of six credits for the M.S. degree or twelve credits for the Ph.D. degree.

ENME 662 Linear Vibrations. (3) First semester. three lectures a week. Fourier and statistical analysis, transient, steady-state, and random behavior of linear lumped mass systems. normal mode theory; shock spectrum concepts; mechanical impedance and mobility methods. vibrations of continuous media including rods, beams, and membranes.

ENME 664 Dynamics. (3) Fundamentals of Newtonian dynamics which includes kinematics of a particle, dynamics of a particle and system of particles, LaGranges equations, basic concepts and kinematics of rigid body motion, dynamics of rigid bodies, Hamilton's principle. Applications to mechanical engineering problems.

ENME 665 Advanced Topics in Vibrations. (3) Prerequisite: ENME 662. Geometrical and numerical analysis of nonlinear and damped vibration systems. Vibration under combined loading of bending, shear and torsion. Random vibrations.

ENME 670 Continuum Mechanics. (3) First semester. Three lectures a week. The algebra and calculus of tensors in Riemannian space are developed with special emphasis on those aspects which are most relevant to mechanics. The geometry of curves and surfaces in E–3 is examined. The concepts are applied to the derivation of the field equations for the non-linear theory of continuous media and to various problems arising in classical dynamics.

ENME 671 Linear Theory of Elasticity. (3) Second semester. Three lectures per week. The basic equations of the linear theory are developed as a special case of the non-linear theory. The first and second boundary value problems are discussed together with the problem of uniqueness. Solutions are constructed to problems of technical interest through semi-inverse, transform and potential methods. Included are the study of plane problems, torsion, dynamic response of spherical shells and tubes, microstructure and anisotropic materials.

ENME 677 Applied Elasticity. (3) Prerequisite: MATH 462 or equivalent. Analysis of stress and strain, equilibrium and compatibility conditions, plane stress and plane strain problems, torsion and flexure of bars, general three dimensional analysis, energy methods, thermal stresses, and wave propagation.

ENME 678 Fracture Mechanics. (3) An advanced treatment of fracture mechanics covenng in detail the analysis concepts for determining the stress intensity factors for various types of cracks. Advanced experimental methods for evaluation of materials or structures for fracture toughness. Analysis of moving cracks and the statistical analysis of fracture strength. Finally, illustrative fracture control plans are treated to show the engineering applications of fracture mechanics.

ENME 680 Experimental Mechanics. (3) Prerequisite: Undergraduate course in instrumentation or equivalent. Advanced methods of measurement in solid and fluid mechanics. Scientific photography, moire, photoelasticity, strain gages, interferometry, holography, speckle, ndt techniques, shock and vibration, and laser anemometry.

ENME 681 Engineering Acoustics. (3) Analogies in electrical, mechanical, and acoustical systems. Mathematical treatment of electro-mechano-acoustical systems such as speakers, horns and microphones. Wave equation and its solution to phenomena involving the propagation, refraction and transmission of sound. Acoustical measurements and interpretation of results towards noise control. Propagation of spherical waves and the radiation of sound. Architectural acoustics.

ENME 682 Nonlinear Solids. (3) Prerequisite: ENME 700. A survey course dealing with first pnncipals nonlinear mechanics. An overview of the classical rheological relations. Theory of creep deformation, viscoelastic deformation and plastic deformation. Emphasis on the more elementary aspects of each topic. Applications to simple engineering problems.

ENME 683 Plates and Shells. (3) Prerequisites: ENME 677 or an equivalent course in elasticity. Theory of surfaces; fundamental equations of thin elastic shells and the specialization of these to the case of flat plates. Problems solved involving orthotropic plates and shells. Shells of revolution under arbitrary loading. Computer usage for the solution of shell and plate problems.

ENME 700 Advanced Mechanical Engineering Analysis I. (3) An advanced, unified approach to the solution of mechanical engineering problems, emphasis is on the formulation and solution of equilibrium, eigenvalue and propagation problems. Review and extension of undergraduate material in Applied Mathematics with emphasis on problems in heat transfer, vibrations, fluid flow and stress analysis which may be formulated and solved by classical procedures.

ENME 701 Advanced Mechanical Engineering Analysis II. (3) Formulation and solution of mechanical engineering problems. Analysis of oscillatory and non-oscillatory systems utilizing discrete parameter techniques including matrix methods, finite element methods, finite differences and numerical integration. Study of non-linear vibration and control systems with emphasis on perturbation theory and stability analysis. Engineering applications of statistical analysis.

ENME 703 Mechanical Engineering Laboratory. (3) Prerequisite: An undergraduate course in instrumentation or equivalent. Two lectures and one laboratory per week. Theory of measurements, and art and science of using instruments. Instrumentation for measuring fluid flow, temperature and heat, stress and strain, and sound and vibrations. Introduction to non-destructive testing, optical techniques and electronic data processing. Design, conduction and analysis of an experiment.

ENME 760 Advanced Structural Dynamics I. (3) Advanced topics in structural dynamics analysis: dynamic properties of matenals, impact and contact phenomena, wave propagation, modern numerical methods for complex structural systems, analysis for wind and blast loads, penetration loads, and earthquake, non-linear systems, random vibrations and structural failure from random loads. Prerequisites: ENME 602, 603 or equivalent.

ENME 788 Seminar. (1–3) First or second semester. Credit in accordance with work outlined by Mechanical Engineering staff. Prerequisite: Graduate standing in Mechanical Engineering.

ENME 799 Master's Thesis Research. (1–6)

ENME 808 Advanced Topics in Mechanical Engineering. (2–3)

ENME 899 Doctoral Dissertation Research. (1–8)

Meteorology Program

Professor and Chairman: Baer
Professors: Vernekar
Professor Emeritus: Landsburg
Research Professor: Faller
Visiting Professor: Fritz, Mintz
Associate Professors: Ellingson, Rodenhuis, Thompson
Assistant Professors: Mass, Pinker, Pitter, Robock
Adjunct Professors: Holland, North
Visiting Lecturers: Kalnay-Rivas, Schemm, Schoeberl

The Meteorology Department offers a full course of study leading to the degrees of Master of Science and Doctor of Philosophy specializing in the atmospheric sciences. Additionally, a full complement of course work in meteorology is offered at the upper division and graduate level as a service to other campus graduate programs.

The educational program in the atmospheric sciences is broadly based, involving many of the applications of the mathematical, physical and applied sciences that characterize modern meteorology. Areas of research specialization presently receiving the most concentrated attention are atmospheric dynamics, atmospheric radiative transfer, remote sensing of the atmosphere, dynamic climatology, numerical weather prediction, turbulence, diffusion and micrometerology.

The Meteorology Program is in the Division of Mathematical and Physical Sciences and Engineering and maintains close research and teaching associations with the Division's Institute for Physical Science and Technology.

Admission and Degree Information

The advanced degree programs in meteorology are open to students holding the bachelor's degree in meteorology, physics, chemistry, mathematics, astronomy, engineering or other programs with suitable emphasis in the sciences. Comprehensive, undergraduate level courses in meteorology are provided for students from disciplines other than meteorology.

To qualify for the Master of Science degree in meteorology, the candidate is required to complete the following graduate level core course work: METO 610—Dynamic Meteorology 1 (3 credits); METO 612—Atmospheric turbulence and Diffusion (3 credits); METO 620—Atmospheric Radiation (3 credits). METO 640—Micrometeorology may be substituted for METO 612 at the advisor's discretion.

A minimum of 21 additional hours of credit, including research, is required. At least 12 credits must be in meteorology at the 600 level or above, and generally no more than 6 credits of 400 level meteorology courses can be applied to the degree. The program may include up to nine credits of course work at the 400 level or above in other departments.

The Master's degree program will consist of a coherent program in one of four options: Atmospheric Physics, Atmospheric Dynamics, Micrometeorology and Air Pollution, and Applied Climatology. Students may elect either a thesis option or a non-thesis option, consisting of one scholarly review paper and a comprehensive examination. A final oral examination is administered prior to the award of the degree. Full-time students with an appropnate background in meteorology can complete the M.S. program in one calendar year. Additional

time may be necessary for students entering from other disciplines.

To qualify for the Ph.D. degree, the candidate must select a major and an ancillary course work program. Ancillary course work programs are individually tailored to the needs and interests of the student. Each student is expected to develop a major course work program with his advisor which will provide adequate preparation for the candidacy exams and adequate background for a successful research program leading to a Ph.D. dissertation. Because of the diversity of subject matter in meteorology, due consideration will be given to the area of specialization of the individual student, although the comprehensive nature of the examination will not be compromised. Students who satisfy minimum requirements on the written examinations will be admitted to oral examinations. A single pass-fail outcome of the examinations will be determined from a combination of written and oral grades with standards in each category set to assure an adequate professional level of performance.

There is no special language requirement for the Ph.D. degree program in meteorology. Ability to do independent research must be shown by a written dissertation which embodies an original contribution to knowledge, on some topic connected with meteorology. Departmental requirements for the dissertation are essentially the same as Graduate School requirements. Typically, Ph.D. programs in meteorology require from three to five years of study beyond the bachelor's degree depending on the prior education and training of the candidate.

Facilities and Special Resources

Special facilities supporting the teaching and research activities of the Meteorology Department include continuous weather facsimile equipment on line with the National Weather Service synoptic data network, facsimile equipment for National Weather Service meteorological radar network, a synoptics laboratory, solar radiation monitoring station, Automatic Picture Transmission satellite receiving station, weather instrument station (NOAA cooperative observing station), mobile micrometeorological survey vehicle, laboratory for analysis of air pollution samples, special laboratory facility for fluid dynamic experimentation in rotating systems, linear wind-wave tank for studying the interaction of water waves and wind.

Special data collections supporting the teaching and research activities include northern hemisphere meteorological data tabulations on microfilm, unique historical daily weather map series dating back to 1899, complete set of climatological data for the United States dating back to 1917, files of the (former) NOAA State Climatologist for Maryland, Synchronous Meteorological Satellite data archive including visible and infra-red photography and film loops, and meteorological data for four outlying weather stations on University farms.

The Meteorology Department has a modern teaching laboratory in which educational color video tapes and 16 mm films may be produced and/or played back. Sufficient equipment is installed to allow students and faculty to produce their own educational materials for classroom and seminar use as well as to record experiments, field trials or lecture events.

Aside from general library facilities on the campus, there is, within the Meteorology Department, a specialized library with several hundred text and reference books in meteorology and allied sciences, many specialized series of research reports and many current journals in meteorology and related fields. Access to the vast holdings of the atmospheric Sciences Library of NOAA at Silver Spring, Maryland, within about 20 minutes of the campus, has been arranged.

Adjacent to the Meteorology Department is the University's Computer Science Center. The Department also has a computer terminal facility which provides remote access to computers at the National Center for Atmospheric Research in Boulder, Colorado, and to the NASA Goddard Space Flight Center in Greenbelt, Maryland.

Professional interactions with the major federal agency in the atmospheric, oceanographic and hydrologic sciences are provided under a formal Memorandum of Agreement with NOAA. This agreement provides for the development of special courses and seminars by visiting faculty from these agencies as well as opportunities for faculty and students to work on site at NOAA facilities. In addition, through membership in the University Corporation for Atmospheric Research, the Meteorology Department enjoys the common facilities offered by the National Center for Atmospheric Research at Boulder, Colorado.

Financial Assistance

Graduate Assistantships are available to qualified graduate students. Research Assistants carry on research in the general areas of synoptic and dynamic meteorology, satellite meteorology, micrometeorology and air pollution, theoretical or experimental fluid dynamics, atmospheric radiation, and general circulation. Stipends are dependent on the student's background and experience and are maintained at a competitive level.

Additional Information

Application material or additional information may be obtained by writing: Director, Meteorology Program, Space Sciences Building, University of Maryland.

Courses

METO 410 Descriptive and Synoptic Meteorology I. (3) Prerequisites: MATH 241, PHYS 294 or PHYS 263 or equivalent. METO 441 is suggested as a companion course with METO 411. An introduction to broad range of theoretical and applied studies in meteorology in order to acquaint him with the interaction of the physical and dynamic processes and the various scales of atmospheric phenomena. Introduction to radiational energy transfer in the atmosphere, earth-atmospheric energy budgets, atmospheric thermodynamics, statics and mechanics and a survey of the general distribution of temperature, pressure, moisture and wind in the atmosphere.

METO 411 Descriptive and Synoptic Meteorology II. (3) Prerequisite: METO 410. METO 442 suggested as a companion course. A continuation of METO 410 including an introduction to the concepts of vorticity and circulation in the atmosphere, properties of cold fronts and warm fronts, cyclones and anticyclones, air masses, thunderstorms, elements of dynamic weather forecasting, microphysics of cloud formation and precipitation, turbulence and diffusion in the atmosphere.

METO 412 Physics and Thermodynamics of the Atmosphere. (3) Prerequisites: MATH 241, PHYS 284 or equivalent. Optical phenomena, the radiation balance, introduction to cloud physics, atmospheric electrical phenomena, basic thermodynamic processes and their application to the atmosphere.

METO 413 Atmospheric Processes on Molecular and Atomic Scale. (3) Prerequisite: Senior or graduate standing in the physical or engineering sciences, at least one year of college physics: a familiarity with differential and integral calculus. An introduction to atmospheric processes with an emphasis on atomic and molecular effects. Theories of the gas phase interactions of neutral atoms and molecules and charged particles applied to meteorological and atmospheric topics.

METO 416 Introduction to Atmospheric Dynamics. (3) Prerequisites: MATH 241, 246; PHYS 263. The equations of atmospheric motion; coordinate systems; balanced flows and elementary application; divergence; circulation and vorticity; the planetary boundary layer; diagnostic analysis with the quasi-geotrophic equations.

METO 420 Physical and Dynamical Oceanography. (3) Prerequisite: METO 410 or a basic course in fluid dynamics such as ENME 340. Historical review of oceanography; physical, chemical, stratification and circulation properties of the ocean; dynamics of frictionless, frictional, wind driven and thermohaline circulation; air-sea interactions.

METO 422 Oceanic Waves, Tides and Turbulence. (3) Prerequisite: METO 420. Introduction to the theory of oceanic wave motions; tides, wind waves, swells, storm surges, seiches, insunamis, internal waves, turbulence, stirring, mixing and diffusion; probability, statistics and time series.

METO 434 Air Pollution. (3) Prerequisite: Senior standing in science or engineering or consent of the instructor. Classification of atmospheric pollutants and their effects on visibility, inanimate and animate receptors. Evaluation of source emissions and principles of air pollution control; meteorological factors governing the distribution and removal of air pollutants; air quality measurements and air pollution control legislation.

METO 441 Weather Map Discussion and Practice Forecasting I. (1) Prerequisite: METO 301 or equivalent. Corequisite: METO 410. Discussion of current weather situation on the basis of information received by facsimile from National Meteorological Center. Use of computer-produced prognostic information, critique of previous forecast, and briefing on expected weather conditions by experienced forecasters. Preparation of practice forecasts, using all available information. Readings in synoptic meteorology.

METO 442 Weather Map Discussion and Practice Forecasting. (1) Prerequisite: METO 441. A continuation of METO 441.

METO 460 Synoptic Laboratory I. (3) Prerequisite: METO 411 or equivalent. Two three-hour laboratory periods per week. Weather map plotting; methods of map analysis; upper air analysis; radar charts; satellite data integration into map analyses. Procedures for prognostic charts. Mesoscale analysis. Use of computer produced diagnostic and prognostic material. Orientation lectures followed by laboratory practice.

METO 461 Synoptic Laboratory II. (3) Prerequisite: METO 460. A continuation of METO 460.

METO 499 Special Problems in Atmospheric Science. (1–3) Prerequisite: Consent of instructor. Research or special study in the field of meteorology and the atmospheric and oceanic sciences. Repeatable to a maximum of 6 credits.

METO 610 Dynamic Meteorology I. (3) Prerequisites: METO 412, 416; MATH 400. Review of dynamic equations; the stress tensor and viscous flow; the barotropic and quasi-geostrophic assumptions; potential vorticity. Scale analysis, linear wave theory; instability mechanisms, especially baroclinic instability in the atmosphere; atmospheric energy propagation. numerical weather prediction; the general circulation.

METO 611 Dynamic Meteorology II. (3) Prerequisite: METO 610. Advanced topics in atmospheric wave motion and stability analysis concentrating on the subsynoptic scales: geostrophic adjustment and energy propagation with application to mountain waves; thermal convection with application to the atmosphere and especially tropical meteorology; the planetary boundary layer; numerical modeling of atmospheric phenomena on the mesoscale.

METO 612 Atmospheric Turbulence and Diffusion. (3) Prerequisites: METO 610 or equivalent. Statistical description of turbulence; the profiles of temperature and wind near the ground; the vertical transport of momentum, heat and water vapor; spectra and scales of atmospheric turbulence; recent theories of turbulent shear flow and convection.

METO 614 Numerical Weather Prediction. (3) Prerequisites: METO 611 or equivalent. Numerical techniques for the solution or partial differential equations; application to the equations of atmospheric motion; Eulerian, LaGrangian and spectral methods; numerical models of the general circulation; current applications to research and forecasting.

METO 616 Planetary Fluid Dynamics. (3) Prerequisites: METO 412, 610 or equivalent. The structure of the atmospheres of the earth and other planets; analytical, numerical and experimental models of the circulations of planetary atmospheres and oceans; tidal motions.

METO 617 General Circulation of the Atmosphere. (3) Prerequisite: METO 610 or equivalent. Derivations of equations for mean axially symmetric field, mean axially asymmetric field and transient field of atmospheric motion; observed circulation, budget of heat, momentum and water vapor; energetics; numerical simulation of the atmosphere.

METO 620 Atmospheric Radiation. (3) Prerequisite: METO 412 or equivalent. Radiant energy-concepts and definitions; radiation absorption and scattering in the atmosphere; direct and diffuse solar radiation; thermal radiation; the radiation balance and climate.

METO 625 Satellite Meteorology. (3) Prerequisite: METO 416, METO 620. Technical review of the satellite program and instrumentation systems of the United States and/or other countries; a brief survey of the use of visible, infrared and microwave imagery from satellites in weather analysis and forecasting; an extensive review of techniques for estimating sea surface temperature and atmospheric temperature and moisure profiles from satellite measurements.

METO 630 Statistical Methods in Meteorology. (3) Prerequisites: METO 411, STAT 400 or equivalent. Tests of significance; time series analysis; analysis of variance; multiple regression and screening multiple regression; representation of meteorological field variables by orthogonal polynomials and empirical orthogonal polynomials; application of multiple discriminant analysis to the meteorological prediction.

METO 634 Air Sampling and Analysis. (3) Prerequisite: METO 434 or consent of instructor. Two lectures and one laboratory per week. The theory and techniques utilized in the determination of gaseous and particulate atmospheric pollutants. Reduction and representation of data and consideration in sampling site selection.

METO 640 Micro-Meteorology. (3) Prerequisites: METO 410, 411 or equivalent. A study of energy balances at the earth-atmosphere interface; statistical and spectral analysis of turbulence; turbulent transfer of energy and momentum; air motions in relation to terrain and landscape; the time and spatial variations of mechanical and thermodynamical quantities in the micro-layer of the atmosphere.

METO 641 Meteorology of Air Pollution. (3) Prerequisites: METO 410, 411 or equivalent. Review of basic macro-and micro-meteorological considerations; the nature and behavior of atmospheric aerosols; the description and measurement of the distribution, dispersion, and other properties of air pollution; study of the meso-meteorology of cities and the climatological influences of air pollution.

METO 646 Atmospheric Optics. (3) Prerequisites: METO 412, 413, MATH 246 or equivalent. Quantitative assessment of radiative energy transfers in the atmosphere; absorption and scattering by atoms, molecules and particulates; emission by excited species. Spectroscopic analysis methods; laser assay of atmosphere for natural species and pollutants.

METO 658 Special Topics in Meteorology. (1–3) Prerequisite: Consent of instructor. Various special topics in meteorology are given intensive study. The topic of concentration varies, from semester to semester and depends on student and faculty interests. Often, specialists from other institutions are invited to the campus on a visiting lectureship basis to conduct the course.

METO 698 Seminar in Meteorology. (1) Prerequisite: Consent of instructor. This seminar will cover selected topics of current meteorological interest. Presentations will be by staff members, advanced graduate students and invited guest speakers.

METO 699 Seminar in Meteorology. (1) Prerequisite: Consent of instructor. This seminar will cover selected topics of current meteorological interest. Presentations will be by staff members, advanced graduate students and invited guest speakers.

METO 799 Master's Thesis Research. (1–6)

METO 899 Doctoral Dissertation Research. (1–8)

Microbiology Program

Professor and Chairman: Cook
Professors: Colwell, Cooney, Doetsch, Hetrick, Young
Associate Professors: MacQuillan, Roberson, Voll, Weiner
Assistant Professors: Howard, McNicol, Sjoblad

The Department of Microbiology offers programs leading to the degrees of Master of Science and Doctor of Philosophy, with special emphasis on two major areas: biomedical and environmental microbiology. In the biomedical area, a student may specialize in virology, immunology and medical bacteriology. Environmentally related research projects are being conducted in microbial ecology, marine microbiology, diseases of fin fish and shellfish, microbial food webs, environmental carcinogenesis, biodegradation of pollutants, and radiation effects. In addition, graduate students carry out research in microbial systematics, industrial fermentations, bacterial and yeast genetics, motility systems of microorganisms, molecular biology of plasmids, DNA repair systems and the control of bacterial morphogenesis. The Department maintains a basic science orientation and consequently has no hospital or clinical affiliations.

Admission and Degree Information

Qualified students are accepted in either the M.S. or Ph.D. programs. Applicants for the M.S. program must have acquired a thorough foundation in biological and physical sciences. A strong background in microbiology is desirable but not essential. However, lack of specific courses may lengthen the time required for earning this degree. Scores on the Graduate Record Examinations (GRE), both the Aptitude Test and the Advanced Test in Biology, must accompany applications. Normally, candidates for the Ph.D. program will have acquired an M.S. degree. GRE scores are required.

Requirements for the M.S. degree include a minimum of 24 semester hours exclusive of research credits. A written thesis, based upon research, is required, and all candidates must pass a final oral examination given by an advisory committee. All candidates for graduate degrees must serve as laboratory teaching assistants for at least one semester. Candidates normally require about two years to complete the M.S. program, but quality of performance alone determines awarding of the degree.

Candidates for the Ph.D. degree in addition to the above-listed requirements, must successfully complete a written preliminary examination. From subjects outside the Department, candidates must choose supporting minor course-work totaling 24 hours. Usually, two to three years following receipt of an M.S. degree are needed to fulfill all requirements for this degree.

Facilities and Special Resources

The Department maintains facilities which permit research in all of the listed areas of specialization. The program in marine microbiology has access to laboratory equipped vessels suitable for research in the Chesapeake Bay and other nearby waters.

Financial Assistance

A limited number of graduate teaching assistantships are available. There are also opportunities for research assistantships, contingent upon current research funding.

Additional Information

Interested individuals may request an information brochure describing in detail the Program of Graduate Study in Microbiology. For information write to: Chairman, Graduate Admissions Committee, Department of Microbiology, University of Maryland

Courses

MICB 400 Systematic Microbiology. (2) Two lecture periods a week. Prerequisite: 8 credits in Microbiology or consent of instructor. History and philosophy of classification. Alpha, numerical and molecular genetic taxonomy. Methods used in microbial identification and classification.

MICB 410 History of Microbiology. (1) Prerequisite: A major in microbiology or consent of instructor. History and integration of the fundamental discoveries of the science. Modern aspects of abiogenesis, fermentation, and disease causation in relation to early theories.

MICB 420 Epidemiology and Public Health. (2) Prerequisite: MICB 200. History, characteristic features of epidemiology; the important responsibilities of public health; vital statistics.

MICB 430 Marine Microbiology. (2) Morphology, biochemistry and ecology of marine microorganisms including fungi, yeasts, bacteria and viruses. Properties of marine bacteria, such as luminescence, metal ion requirements for growth, production of ectocrine compounds, and sampling and culturing marine microorganisms, are covered.

MICB 431 Marine Microbiology Laboratory (3) One lecture and two three-hour laboratory periods per week. Prerequisites: MICB 200 and permission of the instructor. Morphology, biochemistry and ecology of marine microorganisms. Properties of marine bacteria; luminescence, metal ion requirements, ectocrine compound production, sampling and culturing. Laboratory may include sampling trips in Chesapeake Bay and a deep sea research cruise.

MICB 440 Pathogenic Microbiology. (4) Two lectures and two two-hour laboratory periods a week. Prerequisite: MICB 200. The role of bacteria and fungi in the diseases of man with emphasis upon the differentiation and culture of microorganisms, types of disease, modes of disease transmission, prophylactic, therapeutic, and epidemiological aspects.

MICB 450 Immunology. (4) Two lectures and two two-hour laboratory periods a week. Prerequisite: MICB 440. Principles of immunity; hypersensitiveness. Fundamental techniques of immunology.

MICB 460 General Virology. (3) Prerequisite: MICB 440 or equivalent. Discussion of the physical and chemical nature of viruses, virus cultivation and assay methods, virus replication, viral diseases with emphasis on the oncogenic viruses, viral genetics, and characteristics of the major virus groups.

MICB 470 Microbial Physiology (3) Prerequisite: MICB 200. Pre- or co-requisite: BCHM 462. Microbial cellular and population growth. Fermentation metabolism, physiology of anaerobiosis, and energy conservation and transformation in bacterial membranes. Efficiency of energy utilization for growth. Membrane structure and transport. Bacterial chemotaxis. Regulation of bacterial chromosome replication, rna and protein synthesis. Control of metabolic pathways.

MICB 480 Microbial Ecology (3) Prerequisites: MICB 200 and CHEM 201–202. Interaction of microorganisms with the environment, other microorganisms and with higher organisms. Roles of microorganisms in the biosphere. Microorganisms and current environmental problems.

MICB 490 Microbial Fermentations. (2) Second semester. Prerequisite: MICB 470. Principles and practice in industrial fermentation processes, and the study of fermentative metabolism in microorganisms.

MICB 491 Microbial Fermentations Laboratory. (2) Second semester. Two two-hour laboratory periods a week. Prerequisite: MICB 490, or concurrent registration in MICB 490, and consent of instructor. Methods for the conduct, control and analysis of fermentation processes.

MICB 674 Bacterial Metabolism. (2) Second semester. Prerequisite: 30 credits in Microbiology and allied fields, including CHEM 461 and 462. Bacterial nutri-

tion, enzyme formation, metabolic pathways and the dissimilation of carbon and nitrogen substrates.

MICB 688 Special Topics. (1–4) First semester. Prerequisite: Twenty credits in Microbiology. Presentation and discussion of fundamental problems and special subjects in the field of microbiology.

MICB 689 Special Topics. (1–4) Second semester. Prerequisite: Twenty credits in Microbiology. Presentation and discussion of fundamental problems and special subjects in the field of Microbiology.

MICB 704 Medical Mycology. (4) Two lectures and two two-hour laboratory periods a week. Prerequisites: MICB 440 and 8 additional hours in Microbiology or advance courses in allied biological fields. MICB 450 is strongly recommended. Primarily a study of fungi associated with human and animal diseases, with practice in the methods of isolation and identification.

MICB 714 Cytology of Bacteria. (2) A colloquium for graduate students in biological sciences covering structure-function relationships in bacteria. Formal presentations are required. Prior or concurrent enrollment in ANSC 610 and or ZOOL 612 is recommended.

MICB 750 Advanced Immunology. (2) Second semester. Antigens, antibodies, and their interactions. Research fundamentals in Immunology and Immunochemistry.

MICB 751 Immunology Laboratory. (2) Second semester. Two three-hour laboratory sessions a week. Prerequisite: Consent of the instructor. Techniques in Experimental Immunology and Immunochemistry.

MICB 760 Virology and Tissue Culture. (2) Second semester. Prerequisite: MICB 440 or equivalent. Physical, chemical and biological properties of viruses; viral replication; major virus groups.

MICB 761 Virology and Tissue Culture Laboratory. (2) Second semester. Two three-hour laboratory periods a week. Prerequisite: MICB 440 or equivalent. Registration only upon consent of instructor. Laboratory methods in Virology with emphasis on cell culture techniques.

MICB 774 Advanced Bacterial Metabolism. (1) Second semester. Prerequisite: Consent of instructor. A discussion of recent advances in the field of bacterial metabolism with emphasis on metabolic pathways of microorganisms.

MICB 780 Genetics of Microorganisms. (2) First semester. Prerequisite: Consent of instructor. An introduction to genetic principles and methodology applicable to microorganisms. Cellular control mechanisms and protein biosynthesis.

MICB 781 Microbial Genetics Laboratory. (2) Two three-hour laboratory meetings per week. Prerequisite: Consent of the instructor. A laboratory course designed to acquaint students with the techniques employed in studying gene control of microbial activities.

MICB 788 Seminar. (1) First semester.

MICB 789 Seminar. (1) Second semester.

MICB 799 Master's Thesis Research. (1–6)

MICB 899 Doctoral Dissertation Research. (1–8)

Music Program

Professor and Chairman: Gordon
Professors: Berman, Bernstein, Folstrom, Garvey, Gordon, Heim, Helm, Hudson, Johnson, Montgomery, Moss, Traver, Troth, True
Associate Professors: Barnett, Davis, Head, Meyer, Pennington, Schumacher, Serwer, Snapp, Urban, Wakefield
Assistant Professors: McDonald Toliver, Turek, Wexler, Wilson

The Department of Music offers specialized musical training of a highly professional nature which culminates in one of several graduate degrees. The Master of Music degree is offered in five areas of specialization: music performance, historical musicology and ethnomusicology, theory, composition, and conducting. The Doctor of Philosophy degree is offered in musicology (historical, theoretical and ethnomusicology concentrations). The Doctor of Musical Arts degree is offered in literature-performance and in composition. Specializations in music education are offered in cooperation with the College of Education and culminate in Master of Arts, Master of Education, Doctor of Education, or Doctor of Philosophy degrees. Specific requirements and course offerings for those degrees are described under the program descriptions of that college.

Admission and Degree Information

Admission to graduate programs in music is highly selective and based upon satisfactory completion of appropriate undergraduate preparations. Evidence of established musical proficiencies must be demonstrated by audition, examination in music literature and theory, and/or original musical scores. A personal interview is sometimes requested of applicants.

In addition to the requirements for the Doctor of Philosophy degree, admission to candidacy for the Doctoral of Musical Arts major in composition requires placement and qualifying examinations, presentation of a lecture recital and a program of the student's own compositions. The dissertation must be the student's original composition of major proportions. Applicants for admission to candidacy in the Performance-Literature Program must satisfactorily complete placement and qualifying examinations, present a lecture recital and two full-length recitals.

Facilities and Special Resources

In addition to the superb library holdings of the campus itself, the adjacent city of Washington, D.C., affords graduate students in music an unexcelled opportunity for specialized research and musical exposure and development in a variety of private and public agencies, such as the Library of Congress, the Smithsonian Institution, and the John F. Kennedy Center for the Performing Arts.

Financial Assistance

A limited number of competitive graduate assistantships are available. Preference is given to those who have filed the application for admission and been officially admitted to the university.

Courses

Music Education

MUED 410 Instrumental Arranging. (2) Prerequisites: MUSC 250 and permission of instructor. Arranging for school bands and orchestras from the elementary through high school levels.

MUED 411 Instrumental Music: Methods and Materials for the Elementary School. (3) A comprehensive study of instructional materials and teaching techniques for beginning instrumental classes—winds, strings and percussion.

MUED 420 Instrumental Music: Methods, Materials and Administration for Secondary School. (2) A comprehensive study of instructional and program materials, rehearsal techniques and program planning for junior and senior high school bands and orchestras. Organization, scheduling, budgeting and purchasing are included.

MUED 438 Special Problems in the Teaching of Instrumental Music. (2–3) Prerequisite: MUSC 113–213 or the equivalent. A study, through practice on minor instruments, of the problems encountered in public school teaching of orchestral instruments. Literature and teaching materials, minor repairs, and adjustment of instruments are included. The course may be taken for credit three times in one of four groups of instruments: strings, woodwind, brass or percussion will be studied each time the course is offered.

MUED 450 Music in Early Childhood Education. (3) Prerequisite: MUSC 155 or equivalent. Creative experiences in songs and rhythms, correlation of music and everyday teaching with the abilities and development of each level; study of songs and materials; observation and teaching experience with each age level.

MUED 460 Creative Activities in the Elementary School. (2–3) Prerequisite: Music methods or teaching experience. A study of the creative approach to the development of music experiences for children in the elementary grades emphasizing contemporary music and contemporary music techniques.

MUED 470 General Concepts for Teaching Music. (1) Corequisite: MUED 411 or 471. Basic philosophical, psychological, educational considerations for a total music program K–12; strategies for teaching tonal and rhythmic concepts; evaluation techniques and field experiences in designated schools.

MUED 471 Methods for Teaching Elementary General Music. (3) A study of curriculum, materials, and teaching techniques for the development of meaningful music experiences which contribute to a sequential musical growth for children in the elementary schools.

MUED 472 Choral Techniques and Repertoire. (2) Prerequisites: MUED 470 and MUSC 490. Rehearsal techniques for developing appropriate diction, tone, production, intonation, phrasing, and interpretation of choral music; examination of a wide variety of repertoire for use by choral performing groups on the elementary and secondary levels.

MUED 478 Special Topics in Music Education. (1–2) Prerequisite: MUED 470 or consent of department. Each topic focuses on a specific aspect of the music instructional program; collectively, the topics cover a wide range of subject matter relevent to today's schools. May be repeated to a maximum of six credits.

MUED 480 The Vocal Music Teacher and School Organization. (2) Prerequisite: Student teaching, previous or concurrent. The role of the vocal music specialist in the implementation of the supervision and administration of the music programs in the elementary and secondary schools. Open to graduate students by permission of instructor.

MUED 499 Workshops, Clinics, Institutes. (2–6) Innovative and experimental dimensions of Music Education will be offered to meet the needs of music teachers and music supervisors and to allow students to individualize their programs. The maximum number credits that may be earned under this course symbol toward any degree is six semester hours; the symbol may be used two or more times until six semester hours have been reached.

MUED 635 Advanced Orchestration and Band Arranging. (3) Prerequisite: MUSC 486 or the equivalent, or consent of instructor. A study of arranging and transcription procedures in scoring for the orchestra and band. Special attention is given to the arranging problems of the instrumental director in the public schools.

MUED 637 Advanced Study—Developing Musicality through Instrumental Music. (3) Analysis of new and established methods and materials for developing musicality. The study of the curriculum for large and small ensembles, and class instruction, and its adaptation to the diverse organizations of today's schools.

MUED 662 Advanced Study—Developing Musicality in Children. (3) Analysis of new and established methods and materials including Orff and Kodaly, and their adaptation to teaching music in the diverse organizations of today's elementary schools. Emphasis on general musical experiences for all children.

MUED 672 Advanced Study—Developing Musicality in the Adolescent. (3) Analysis of new and established methods and materials for developing musicality through classes in general music, music appreciation, music in the humanities, music theory, chorus, small ensembles, and class voice.

MUED 674 Choral Conducting and Repertoire. (3)

MUED 680 Administration and Supervision of Music in the Public Schools. (3) The study of basic principles and practices of supervision and administration with emphasis on curriculum construction, scheduling, budgets, directing of in-service teaching, personnel problems, and school-community relationships.

MUED 690 Research Methods in Music and Music Education. (3) The application of methods of research to problems in the fields of Music and Music Education. The preparation of bibliographies and the written exposition of research projects in the area of the student's major interest.

MUED 692 Foundations of Music Education. (3) Educational thought and its application to instruction and evaluation in Music Education.

MUED 698 Current Trends in Music Education. (2–4) A survey of current and emerging philosophies, methodologies and curricula in Music Education and their implementation. The influence of educational and social changes and the expanding musical scene upon the music programs for children of all ages and for teacher education. The maximum number of credits that may be earned under this course symbol (within established limits of programs) toward any degree, eight semester hours. The symbol may be used two or more times until eight semester hours have been completed.

MUED 890 History of Music Education in the United States. (3) Prerequisite: Permission of the instructor. The study of historical development of pedagogical practices in Music Education, their philosophical implications and educational values.

MUSIC

MUSC 400 Music Pedagogy. (3) Conference course. Prerequisite or corequisite: MUSC 418, or a more advanced course in Applied Music. A study of major pedagogical treatises in music, and an evaluation of pedagogical techniques, materials, and procedures.

MUSC 428 Repertoire Coaching of Vocal or Chamber Music. (2) Prerequisite or corequisite: MUSC 328. A course for piano students who wish to go further than the work offered in MUSC 128, 228, and 328 by becoming specialists in the areas of vocal coaching or chamber music coaching. Elements of pedagogy, conducting, and responsible artistic decision-making for the entire musical production.

MUSC 429 Opera Theater. (2–3) Ten hours per week. Open to music and non-music majors with consent of director. Advanced techniques of operatic production; preparation, rehearsal, and performance of operatic works from both the traditional and contemporary repertory. Repeatable to a maximum of twelve credits.

MUSC 432 Music in World Cultures I (3) Prerequisite: MUSC 130 or permission of instructor. Asian musics from Japan to the Arab countries analyzed in terms of musical, social and aesthetic approaches.

MUSC 433 Music in World Cultures II (3) Prerequisite: MUSC 130 or permission of instructor. Music of the Balkans, Africa, South and North America analyzed in terms of musical, social and aesthetic interrelationships.

MUSC 436 Jazz: Then and Now. (3) Major styles and influential artists of the past 75 years of jazz.

MUSC 438 Area Studies in Ethnomusicology. (3) Prerequisite: MUSC 432 or 433 or equivalent. Advanced study of music in selected regions of the world. Repeatable to a maximum of nine credits provided content is different.

MUSC 439 Collegium Musicum. (1) Prerequisite: Permission of the Instructor. Open to undergraduates and graduates, music majors and non-majors. Procurement, edition, and performance of music not belonging to a standard repertory: early music, compositions for unusual performing media, works which demand reconstruction of their original circumstances of performance. Outcome of a semester's work may be one or more performances for the public. May be repeated for credit five times.

MUSC 443 Solo Vocal Literature. (3) Prerequisite: MUSC 330, 331 or the equivalent. The study of solo vocal literature from the Baroque cantata to the art song of the present. The Lied, melodie, vocal chamber music, and the orchestral song are examined.

MUSC 445 Survey of the Opera. (3) Prerequisite: MUSC 330, 331, or the equivalent. A study of the music, librettos and composers of the standard operas.

MUSC 448 Special Topics in Music. (2–6) Prerequisite: Permission of the instructor. Repeatable to a maximum of six semester hours.

MUSC 450 Musical Form. (3) Prerequisite: MUSC 251. A study of the principles of organization in music with emphasis on eighteenth and nineteenth century European music. Reading and analysis of scores exemplifying the musical forms.

MUSC 451 Analysis of Music. (3) Prerequisite: MUSC 450 or permission of instructor. An advanced course in the analysis of tonal music. Discussion of individual works, with emphasis on their unique characteristics and on the relation of analysis to performance.

MUSC 452 Keyboard Harmony. (2) Prerequisite: MUSC 251. Keyboard performance of musical score for vocal and instrumental ensembles and keyboard realization of basso continuo parts.

MUSC 453 Class Study of Guitar and Recorder. (2) Prerequisite: Consent of instructor or any four of the following: MUSC 102, 103, 113, 114, 116, 117, 120, 121, 202, 203. Three hours per week. Study and development of instrumental technique, pedagogical practices, and materials relating to group performance.

MUSC 457 Electronic Music Composition. (2) Prerequisite: MUSC 250 and permission of instructor. Theory and practice of electronic music, electronically-generated sound, and TTS modulation in the voltage-controlled studio.

MUSC 460 Tonal Counterpoint I. (2) Prerequisite: MUSC 251 or permission of instructor. A course in eighteenth-century contrapuntal techniques, analysis and original composition of two-voice dances, preludes, and inventions.

MUSC 461 Tonal Counterpoint II. (2) Prerequisite: MUSC 460. A continuation of MUSC 460. Analysis and original composition of larger works displaying imitation in more than two voices, including the chorale prelude and fugue.

MUSC 462 Modal Counterpoint. (2) Prerequisite: MUSC 251 or the equivalent. An introduction to the contrapuntal techniques of the sixteenth century: the structure of the modes, composition of modal melodies, and contrapuntal writing for two, three and four voices.

MUSC 465 Canon and Fugue. (3) Prerequisite: MUSC 461 or the equivalent. Composition and analysis of the canon and fugue in the styles of the eighteenth, nineteenth and twentieth centuries.

MUSC 466 Structural Counterpoint. (3) Prerequisite: MUSC 461 or permission of the instructor. A study of counterpoint and its role in articulating large-scale tonal structures with emphasis on analysis and written exercises.

MUSC 467 Piano Pedagogy I. (3) A study of major pedagogical treatises in music, and an evaluation of pedagogical techniques, materials, and procedures.

MUSC 468 Piano Pedagogy II. (3) Prerequisite: MUSC 467. Application of the studies begun in MUSC 467 to the actual lesson situation. Evaluation of results. May be repeated once for credit.

MUSC 470 Harmonic and Contrapuntal Practices of the Twentieth Century. (2) Prerequisite: MUSC 251 or equivalent. A theoretical and analytical study of twentieth century materials.

MUSC 471 Contemporary Compositional Techniques. (2) Prerequisite: MUSC 470 or permission of instructor. Continuation of MUSC 470, with emphasis on the analysis of individual works written since 1945.

MUSC 478 Composition. (2) Prerequisite: MUSC 250, 251. Principles of musical composition, and their application to the smaller forms. Original writing in nineteenth and twentieth century musical idioms for various media.

MUSC 479 Composition. (2) Prerequisite: MUSC 250, 251. Principles of musical composition, and their application to the smaller forms. Original writing in nineteenth and twentieth century musical idioms for various media.

MUSC 480 Music in Antiquity and the Middle Ages. (3) Survey of Western Music from Hellenic Times to 1450.

MUSC 481 Music in the Renaissance. (3) Survey of Western Music from 1450 to 1600.

MUSC 482 Music in the Baroque Era. (3) Survey of Western Music from 1600 to 1750.

MUSC 483 Music in the Classic Era. (3) Survey of Western Music from 1750 to 1820.

MUSC 484 Music in the Romantic Era. (3) Survey of Western Music from 1820 to 1900.

MUSC 485 Music in the 20th century. (3) Survey of Western Music from 1900 to the present.

MUSC 486 Orchestration I. (2) Prerequisite: MUSC 251. A study of the ranges, musical functions and technical characteristics of the instruments and their color possibilities in various combinations. Practical experience in orchestrating for small and large ensembles.

MUSC 487 Orchestration II. (2) Prerequisite: MUSC 486. A study of orchestration in the various historical periods, with emphasis upon stylistic writing projects.

MUSC 490 Conducting. (2) Prerequisite: MUSC 251. Vocal and instrumental baton techniques.

MUSC 491 Conducting II. (2) Prerequisite: MUSC 490 or the equivalent. Baton techniques applied to score reading, rehearsal techniques, tone production, style and interpretation.

MUSC 492 Keyboard Music I. (3) The history and literature of harpsichord and solo piano music from its beginning to the Romantic Period. Emphasis is placed on those segments of repertoire which are encountered in performance and teaching situations at the present time.

MUSC 493 Keyboard Music II. (3) Prerequisite: MUSC 492. The history and literature of harpsichord and solo piano music from the Romantic Period to the present. Emphasis is placed on those segments of repertoire which are encountered in performance and teaching situations at the present time.

MUSC 494 Survey of Theory. (3) Prerequisite: MUSC 251. A study of the major contributions of music theorists from Greek antiquity through the twentieth century.

MUSC 495 Acoustics for Musicians. (3) Prerequisites: MUSC 251 or the equivalent, and senior or graduate standing in music. The basic physics of music, acoustics of musical instruments and music theory, physiological acoustics, and musico-architectural acoustics.

MUSC 499 Independent Studies. (2–3) Prerequisite: Permission of instructor. Independent research on a topic chosen in consultation with the instructor, which may culminate in a paper or appropriate project. May be repeated once for credit.

MUSC 608 Chamber Music Repertoire. (1–3) Prerequisite: Graduate standing as a major in performance. A study, through performance, of diversified chamber music for standard media. May be repeated for credit to the maximum credit designated in the student's major degree program.

MUSC 621 Documents of Theory and Aesthetics: Ancient, Medieval and Renaissance. (3) Writings about music in antiquity, the Middle Ages, and the Renaissance.

MUSC 622 Documents of Theory and Aesthetics: Baroque. (3) Writings about Western Music from 1600 to 1750.

MUSC 623 Documents of Theory and Aesthetics: Classic. (3) Writings about Western Music from 1750 to 1820.

MUSC 624 Documents of Theory and Aesthetics: Romantic. (3) Writings about Western Music from 1820 to 1900.

MUSC 625 Documents of Theory and Aesthetics: 20th Century. (3) Writings about Western Music from 1900 to the present.

MUSC 630 Teaching the Theory, History, and Literature of Music. (3) Prerequisite: Graduate standing and consent of instructor. A course in teaching methodology with emphasis on instruction at the college level.

MUSC 635 American Music. (3) Prerequisite: Permission of instructor. A survey of American Art Music from Colonial Times to present.

MUSC 639 Seminar in Music. (3) Prerequisite: MUSC 330, 331 and consent of instructor. The work of one major composer (Bach, Beethoven, etc.) will be studied. The course may be repeated for credit, since a different composer will be chosen each time it is offered.

MUSC 640 Performance Practice I. (3) Problems in the performance of music lying primarily outside the standard repertory. Mainly for performance majors.

MUSC 641 Performance Practice II. (3) Problems in the performance of music lying primarily outside the standard repertory. Mainly for performance majors. Continuation of MUSC 640.

MUSC 642 Early Music Notation. (3) Aspects of notation in music before 1600; transcription into modern notation.

MUSC 643 Seminar in Solo Vocal Literature I. (3) Preerquisite: MUSC 444 or equivalent. An intensive study of solo vocal literature from its origin to the present.

MUSC 644 Seminar in Solo Vocal Literature II. (3) Prerequisite: MUSC 643 or equivalent. A continuation of MUSC 643 with an emphasis on areas of individual interest.

MUSC 645 Seminar in Vocal Pedagogy. (3) Prerequisite: MUSC 400 or the equivalent. A study of the physiological, psychological and acoustical aspects of the teaching of singing combined with the independent studies and research in areas of individual interest.

MUSC 648 Seminar in Music Research. (3) Prerequisite: MUSC 331 and graduate standing. An introduction to graduate study in the history and literature of music. Bibliography and methodology of systematic and historical musicology.

MUSC 650 The Contemporary Idiom. (3) Prerequisite: MUSC 470 or consent of instructor. Analysis of various works of the twentieth century.

MUSC 662 Advanced Modal Counterpoint. (3) Prerequisite: MUSC 461 or consent of instructor. Composition of music in the style of the Renaissance. Analysis of the music of such composers as Ockeghem, DuFay, Josquin, Palestrina.

MUSC 670 Advanced Analytical Techniques I. (3) Prerequisite: MUSC 451 or consent of instructor. Analysis of representative masterpieces of the eighteenth and early nineteenth centuries.

MUSC 671 Advanced Analytical Techniques II. (3) Prerequisite: MUSC 451 or consent of instructor. Analysis of representative masterpieces of the nineteenth and early twentieth centuries.

MUSC 675 Music Theory Pedagogy (3) Analysis of introductory level music theory courses, evaluation of text materials, and teaching approaches for music fundamentals, aural training, and basic undergraduate theory programs.

MUSC 678 Seminar in Musical Composition. (3) Prerequisite: MUSC 479 or equivalent, and graduate standing. An advanced course in musical composition. May be repeated for credit.

MUSC 679 Seminar in Ethnomusicology. (3) Prerequisite: MUSC 434–435. Selected problems in Ethnomusicology. Independent research in such topics as transcription, analysis, and taxonomy.

MUSC 680 Seminar in Music of Antiquity and the Middle Ages. (3) Research topics in music from antiquity to 1450.

MUSC 681 Seminar in Music of the Renaissance. (3) Seminar in music of the Renaissance. Research topics in music from 1450 to 1600.

MUSC 682 Seminar in Music of the Baroque Era. (3) Seminar in music of the Baroque Era. Research topics in music from 1600 to 1750.

MUSC 683 Seminar in Music of the Classic Era. (3) Seminar in music of the Classic Era. Research topics in music from 1750 to 1820.

MUSC 684 Seminar in Music of the Romantic Era. (3) Seminar in music of the Romantic Era. Research topics in music from 1820 to 1900.

MUSC 685 Seminar in Music of the 20th Century. (3) Seminar in music of the twentieth century. Research topics in music from 1900 to the present.

MUSC 688 Advanced Orchestration. (3) Prerequisite: MUSC 487 or the equivalent, and graduate standing. Orchestration projects in the styles of DeBussy, Ravel, Stravinsky, Schoenberg, Bartok, and others. May be repeated for credit.

MUSC 689 Advanced Conducting. (3) Prerequisite: MUSC 491 or the equivalent. A concentrated study of the conducting techniques involved in the repertoire of all historical periods. May be repeated for credit.

MUSC 696 Factors in Musical Learning. (3) Prerequisite: MUSC 331 or the equivalent and at least one course in psychology. The psychology of intervals, scales, rhythms, and harmony. Musical hearing and creativity. The psychology of musical ability. The theory of functional music.

MUSC 699 Special Topics in Music. (2–6) Prerequisite: Permission of the instructor. Repeatable to a maximum of six semester hours.

MUSC 799 Master's Thesis Research. (1–6)

MUSC 800 Advanced Seminar in Music Pedagogy. (3) Prerequisites: MUSIC 400 or equivalent, doctoral standing and permission of instructor. A detailed study of historical and contemporary methods of pedagogy, and analysis of pedagogical problems. Sectioning by instrument. Required of all candidates for the D.M.A. degree in performance and literature.

MUSC 801 Advanced Seminar in Music Pedagogy. (3) Prerequisites: MUSIC 400 or equivalent, doctoral standing and permission of instructor. A detailed study of historical and contemporary methods of pedagogy, and analysis of pedagogical problems. Sectioning by instrument. Required of all candidates for the D.M.A. degree in performance and literature.

MUSC 830 Doctoral Seminar in Music Literature. (3) Prerequisite: At least twelve hours in music history and literature. An analytical survey of the literature of music: keyboard music; vocal music; string music; wind instrument music; required of all candidates for the D.M.A. degree in literature-performance.

MUSC 831 Doctoral Seminar in Music Literature. (3) Prerequisite: MUSC 830 or consent of instructor. An analytical survey of the literature of music: keyboard music; vocal music; string music; wind instrument music. Required of all candidates for the D.M.A. degree in literature-performance.

MUSC 878 Advanced Composition. (3) Prerequisite: MUSC 678 or the equivalent, and permission of the instructor. Conference course in composition in the larger forms. May be repeated for credit.

MUSC 899 Doctoral Dissertation Research. (1–8)

Music Performance Music performance courses are available in three series:

Minor Series—MUSP 402, 403 Intended for either music majors studying a secondary instrument or non-music majors.

Principal Series—MUSP 409, 410, 609, 610 Intended for majors in music programs other than performance.

Major Series—MUSP 419, 420, 619, 620, 719, 815, 816, 817 Intended for students majoring in performance.

variable credit courses: may be taken for 2 or 4 credits.

Instrument designation: each student taking a music performance course must indicate the instrument chosen by adding a suffix to the proper course number, such as: MUSP 402A music performance—piano. suffix–instrument: A–piano, B–voice, C–violin, D–Viola, E–cello, F–bass, G–flute, H–oboe, I–clarinet, J–bassoon, K–saxophone, L–horn, M–trumpet, N–trombone, O–tuba, P–euphonium, Q–percussion, R–organ, S–guitar, T–composition, U–conducting, V–harp, W–electronic composing, X–hist inst—keyboard, Y–hist inst—strings, Z–hist inst—winds.

400-Level Courses in the Minor Series: Prerequisite: permission of department chairperson. One half-hour private lesson per week plus assigned independent practice.

400-Level Courses in the Principal or Major Series: 2 or 4 credits. Prerequisite: permission of the department chairperson. One-hour private lesson per week plus assigned independent practice.

MUSP 402 Music Performance. (2) Senior course, in the minor series.

MUSP 403 Music Performance. (2) Senior course, in the minor series.

MUSP 409 Music Performance. (2–4) Senior course in the principal series.

MUSP 410 Music Performance. (2–4) Senior course in the principal series. Recital required.

MUSP 419 Music Performance. (2–4) Senior course in the major series.

MUSP 420 Music Performance. (2–4) Senior course in the major series. Recital required.

MUSP 609 Interpretation and Repertoire. (2) Prerequisite: Permission of department chairman and graduate standing in performance in the principal series.

MUSP 610 Graduate Music Performance. (4) Prerequisite: MUSP 609 and permission of department chairman. Recital course in the principal series.

MUSP 619 Interpretation and Repertoire (2–4) Prerequisite: Departmental audition and permission of department chairman. Repeatable to a maximum of 12 credits.

MUSP 620 Graduate Music Performance. (4) Prerequisite: MUSP 619 and permission of department chairman. Recital course in the major series.

MUSP 719 Interpretation and Repertoire (2–4) Prerequisite: Departmental audition, admission to doctoral program in the major series and permission of department chairman. Repeatable to a maximum of 12 credits.

MUSP 815 Interpretation, Performance, and Pedagogy. (4) A seminar in pedagogy and the pedagogical literature for the doctoral performer, with advanced instruction at the instrument, covering appropriate compositions. Required of all candidates for the D.M.A. degree in literature-performance. Prerequisite: Doctoral standing in performance and permission of department chairman. Recital course.

MUSP 816 Interpretation, Performance, and Pedagogy. (4) Recital course. Prerequisite: MUSP 815 and permission of department chairman.

MUSP 817 Interpretation, Performance, and Pedagogy. (4) Recital course. Prerequisite: MUSP 816 and permission of department chairman.

Nuclear Engineering Program

Professor and Director: Munno
Professor and Department Chairman: Cadman
Professors: Duffey, Silverman[1]
Associate Professors: Almenas, Roush,
Assistant Prof: Pertmer

[1] Director, Institute for Physical Science and Technology

The Nuclear Engineering program is in the Department of Chemical and Nuclear Engineering. It has as its primary objective the maintenance and extension of the ever increasing degree of engineering sophistication. The courses and research programs strive to create an atmosphere of originality and creativity which prepares the student for the engineering leadership of tomorrow.

An individual plan of graduate study compatible with the student's interests and background is established by the student, his advisor and the department head. General areas of concentration include reactor safety, reactor thermal/hydraulics, nuclear fuel management, transport theory, activation analysis, energy conversion, reactor physics, radiation engineering, reactor dynamics, radiation shielding and nuclear core design. The general nuclear engineering program is focused toward energy conversion and power engineering with the additional speciality in radiation and polymer science.

Admission and Degree Information

The programs leading to the M.S. and Ph.D. degrees are open to qualified students holding the B.S. degree. Full admission may be granted to students with degrees in any of the engineering and science areas from accredited programs. In some cases it may be necessary to require courses to fulfill the background. The general regulations of the Graduate School apply in reviewing applications.

The candidate for the M.S. degree has the choice of following a plan of study with thesis or without thesis. The equivalent of at least three years of full-time study beyond the B.S. degree is required for the Ph.D. degree. All students seeking graduate degrees in Nuclear Engineering must enroll in ENNU 620, 630, 655 and 440. Many of these courses are offered in the late afternoon and evening. In addition to the general rules of the Graduate School certain special

degree requirements are set forth by the Department in its departmental publications.

Facilities and Special Resources

Special facilities available for graduate study in Nuclear Engineering include the nuclear reactor, a large gamma source, and a 10 MeV Electron Linear Accelerator, neutron generator, and various analyzers and detectors. Activities in these areas are coordinated through the nuclear reactor facility and the laboratory for Radiation and Polymer Science. The nuclear reactor is a 250 KW swimming pool type using enriched uranium.

Courses

ENNU 430 Radioisotope Power Sources. (3) Prerequisite: ENNU 215 or permission of instructor. Principles and theory of radioisotope power sources. Design and use of nuclear batteries and small energy conversion devices.

ENNU 435 Activation Analysis. (3) Prerequisite: ENNU 215 or permission of instructor. Principles and techniques of activation analysis involving neutrons, photons and charged particles. Emphasis placed upon application of this analytical technique to solving environmental and engineering problems.

ENNU 440 Nuclear Technology Laboratory. (3) One lecture and two laboratory periods a week. Prerequisites: MATH 240, PHYS 263. Techniques of detecting and making measurements of nuclear or high energy radiation. Radiation safety experiments. Both a subcritical reactor and the swimming pool critical reactor are sources of radiation.

ENNU 450 Nuclear Reactor Engineering I. (3) Prerequisites: MATH 246 and PHYS 263 or consent of instructor. Elementary nuclear physics, reactor theory, and reactor energy transfer. Steady-state and time-dependent neutron distributions in space and energy. Conduction and convective heat transfer in nuclear reactor systems.

ENNU 455 Nuclear Reactor Engineering II. (3) Prerequisite: ENNU 450. General plant design considerations including radiation hazards and health physics, shielding design, nuclear power economics, radiation effects on reactor materials, and various types of nuclear reactor systems.

ENNU 460 Nuclear Heat Transport. (3) Prerequisite: ENNU 450. Heat generation in nuclear reactor cores, conduction and transfer to coolants. Neutron flux distributions, fission and heat release. Steady and unsteady state conduction in fuel elements. Heat transfer to nonmetallic and metallic coolants. Heat transfer with phase change. Thermal design of reactor cores.

ENNU 461 Chemical Separation in the Nuclear Cycle Reactor Fuel. (3) Prerequisite: ENNU 450 or consent of instructor. An introduction to chemical and physical separation of the nuclear reactor fuel. Basic separation processes, reactor fuel fabrication, reactor chemistry problems and the handling and treatment of radioactive waste. Calculations of plant design and operation. Related safety issues.

ENNU 468 Research. (2–3) Prerequisite: Permission of the staff. Investigation of a research project under the direction of one of the staff members. Comprehensive reports are required. Repeatable to a maximum of six semester hours.

ENNU 470 Introduction to Controlled Fusion. (3) Prerequisite: Senior standing in Engineering or consent of instructor. The principles and the current status of research to achieve controlled thermonuclear power production. Properties of ionized gases relating to confinement and heating. Concepts of practical fusion devices.

ENNU 480 Reactor Core Design. (3) Prerequisite: ENNU 450 or consent of instructor. Design of nuclear reactor cores based on a sequence of standard computer codes. Thermal and epithermal cross sections, multigroup diffusion theory in one and two dimensions and fine structure flux calculations using transport theory.

ENNU 490 Nuclear Fuel and Power Management. (3) Prerequisites: ENNU 460 and 480, or consent of instructor. Physics and economics of the nuclear fuel cycle utilizing existing design codes. Mining, conversion, enrichment, fabrication, reprocessing processes. Effects of plutonium recycle, in-core shuffling, fuel mechanical design and power peaking on fuel cycle costs.

ENNU 609 Seminar in Nuclear Engineering. (1)

ENNU 620 Methods of Engineering Analysis. (3) Application of selected mathematical techniques to the analysis and solution of engineering problems; included are the applications of matrices, vectors, tensors, differential equations, integral transforms, and probability methods to such problems as unsteady heat transfer, transient phenomena in mass transfer operations, stagewise processes, chemical reactors, process control, and nuclear reactor physics.

ENNU 630 Nuclear Reactor Physics I. (3) Prerequisite: ENNU 450 or consent of instructor. Introduction to Neutron Physics. The theory of neutron detection instruments including the neutron chopper and solid state detectors. Elements of neutron slowing-down theory. The Boltzman Transport Equation is developed together with approximations such as PN, SN, and Fermi Age. Nuclear systems are theoretically treated utilizing the diffusion approximation, the Fermi Age Method and the P–3 method. Elementary temperature and time dependence.

ENNU 640 Nuclear Reactor Physics II. (3) Second semester. Prerequisite: ENCH 320. Mathematical treatment of nuclear reactor systems. The foundations of nuclear reactor kinetics, the multigroup treatment, reflected reactor theory, heterogeneous reactors, perturbation theory. Thermalization theory and the pulse and sine-wave techniques. Introduction to variational methods.

ENNU 648 Special Problems in Nuclear Engineering. (1–16)

ENNU 649 Selected Topics in Nuclear Engineering. (2) Two lectures a week. Prerequisite: Permission of instructor. Topics of current interest and recent advances in the Nuclear Engineering field. Because of the rapid advances in the field, information on special topics of much practical importance is continually becoming available. Since the content changes, registration may be permitted.

ENNU 655 Radiation Engineering. (3) Prerequisite: Permission of instructor. An analysis of such radiation applications as synthesizing chemicals, preserving foods, control of industrial processes, design of irradiation installations, e.g., cobalt 60 gamma ray sources, electronuclear machine arrangement, and chemonuclear reactors.

ENNU 656 Radiation Engineering. (3) Prerequisite: Permission of instructor. An analysis of such radiation applications as synthesizing chemicals, preserving foods, control of industrial processes, design of irradiation installations, e.g., cobalt 60 gamma ray sources, electronuclear machine arrangement, and chemonuclear reactors.

ENNU 667 Radiation Effects Laboratory. (3) Prerequisite: Permission of instructor. Effect of massive doses of radiation on the properties of matter for purposes other than those pointed toward nuclear power. Radiation processing, radiation-induced chemical reactions, and conversion of radiation energy; isotope power sources.

ENNU 671 Nuclear Reactor Laboratory. (3) Two lectures and two laboratory periods a week. Prerequisites: Permission of instructor. The University of Maryland swimming pool reactor is employed in experiments on reactor startup and operation, shielding, control, neutron flux distributions, neutron and gamma spectrum, cross section measurements.

ENNU 672 Nuclear Reactor Laboratory. (3) Two lectures and two laboratory periods a week. Prerequisites: Permission of instructor. The University of Maryland swimming pool reactor is employed in experiments on reactor startup and operation, shielding, control, neutron flux distributions, neutron and gamma spectrum, cross section measurements.

ENNU 720 Neutral Particle Transport Theory. (3) First semester. Prerequisite: ENNU 630 or permission of instructor. Transport equations for neutrons and gamma rays. Infinite space and Milne Problems. Spherical harmonic and variational methods. Special methods of solving transport equations.

ENNU 730 Radiation Shielding and Energy Deposition. (3) First semester. Prerequisite: ENNU 630 or permission of instructor. A study of the interactions of nuclear radiations with matter. Includes electron, gamma and neutron attenuation, dose calculations, chemical changes, heat generation and removal in shields

ENNU 740 Nuclear Reactor Dynamics. (3) Second semester. Prerequisite: ENNU 640. Principles of reactor control and operation. Neutron kinetics, temperature and coolant flow effects, transfer function, stochastic processes. Stability analysis. Accident calculations. Use of analog computer or simulation and problem solving.

ENNU 761 Nuclear Fuel and Waste Processing. (3) First semester Three lectures a week. Processing of nuclear fuel and treatment of nuclear waste. Includes: processing of uranium, thorium, and other ores; chemical separation of plutonium, uranium, fission products and other elements from materials irradiated in nuclear reactors; treatment of radioactive wastes; isotopic separation of U235; and isotopic separation of heavy water and other materials.

ENNU 799 Master's Thesis Research. (1–6)

ENNU 840 Nuclear Reactor Design. (3) Prerequisites: ENNU 630 or consent of instructor. The design features of nuclear reactor systems. The preliminary design of a reactor is carried out by the student. Core design including heat transfer, control system, safety systems and shielding. Standard computer programs are utilized throughout.

ENNU 860 Fast Reactor Engineering. (3) Prerequisite: ENNU 630. Engineenng and Physics problems of fast reactors. Neutron economy and breeding. Transport theory based on neutronic core design. Liquid metal and gaseous coolant heat transfer. Aspects of fast reactor plant design.

ENNU 899 Doctoral Dissertation Research. (1–8)

Nutritional Sciences Program

Professor and Chairman: Keeney (Biochemistry)
Professors: Leffel, Young (Animal Science); Goldsby, Holmlund, Keeney, Rollinson (Chemistry); Davis, King, Mattick, Vandersall, Williams (Dairy Science); Ahrens, Beaton, Prather (Food, Nutrition & Institution Administration); Thomas (Poultry Science); Hepner (Pediatrics, UMAB).
Associate Professors: DeBarthe (Animal Science); Campagnoni, Hansen, Lakshmanan, Sampugna (Chemistry); Douglass, Westhoff (Dairy Science); Cox, Williams (Food, Nutrition & Institution Administration); Soares (Poultry Science).
Assistant Professors: Kern, Kunkle, (Animal Science); Mather, Russek, Vijay (Dairy Science); Brady, Caliendo, Moser, Poplai (Food, Nutrition & Institution Administration).

The Graduate Program in Nutritional Sciences offers study leading to the Master of Science and the Doctor of Philosophy degrees. It is an interdepartmental program involving faculty in the Departments of Animal Science, Dairy Science, Chemistry, Food, Nutrition & Institution Administration and Poultry Science on the College Park Campus, and Pediatrics at the University of Maryland, Baltimore City Campus.

Students interested in the program should contact the Chairman of the program for information on specific requirements.

NOTE: Students might be interested in checking the offerings in the Food, Nutrition & Institution Administration Program and in the Food Science Program listed elsewhere in this catalog.

Courses

NUSC 402 Fundamentals of Nutrition. (3) Three lectures per week. A study of the fundamental role of all nutrients in the body, including their digestion, absorption and metablosim. Dietary requirements and nutritional deficiency syndromes of laboratory and farm animals and man will be considered. This course will be for both graduate and undergraduate credit,

with additional assignments given to the graduate students.

NUSC 403 Applied Animal Nutrition. (3) Two lectures and one laboratory period per week. Prerequisites: MATH 110, NUSC 402 or permission of instructor. A critical study of those factors which influence the nutritional requirements of ruminants, swine and poultry. Practical feeding methods and procedures used in formulation of economically efficient rations will be presented.

NUSC 415 Maternal, Infant and Child Nutrition. (2) Two lectures per week. Prerequisite: Course in basic nutrition. Nutritional needs of the mother, infant and child and the relation of nutrition to physical and mental growth.

NUSC 425 International Nutrition. (2) Two lectures a week. Prerequisite: Course in basic nutrition. Nutritional status of world population and local, national, and international programs for improvement.

NUSC 435 History of Nutrition. (2) Two lectures per week. Prerequisite: Course in basic nutrition. A study of the development of the knowledge of nutrition and its interrelationship with social and economic development.

NUSC 450 Advanced Human Nutrition. (3) First semester. Two lectures and one two-hour laboratory. Prerequisites: NUSC 402 or NUTR 300, CHEM 461, 462 or concurrent registration or permission of instructor. A critical study of the physiological and metabolic influences on nutrient utilization, particular emphasis on current problems in Human Nutrition.

NUSC 460 Therapeutic Human Nutrition. (3) Second semester. Prerequisite: NUSC 402 or NUTR 300. Two lectures and laboratory period per week. Modification of normal adequate diet to meet human nutritional needs in pathological conditions.

NUSC 463 Nutrition Laboratory. (2) Prerequisite: ANSC/NUSC 401 or concurrent registration. Six hours of laboratory per week. Digestibility studies with ruminant and monogastric animlas, proximate analysis of various food products, and feeding trials demonstrating classical nutritional deficiencies in laboratory animals.

NUSC 600 Recent Progress in Human Nutrition. (3) First semester. Three lectures per week. Recent developments in the science of Nutrition with emphasis on interpretation for application in health and disease.

NUSC 601 Advanced Ruminant Nutrition. (2) First semester. Two 1-hour lectures and one 2-hour laboratory per week. Prerequisite: Permission of department. Biochemical, physiological and bacteriological aspects of the nutrition of ruminants and other animals.

NUSC 603 Mineral Metabolism. (3) Presentation of basic nutritional data on mineral metabolism with emphasis on interactions of minerals. Trace elements will be given special attention. The role of minerals in metabolic regulation is stressed. Two one-hour lectures/one two-hour discussion period.

NUSC 604 Vitamin Nutrition. (3) Prerequisites: ANSC 401 and CHEM 461. Two one-hour lectures and one two-hour discussion period per week. Advanced study of the fundamental role of vitamins and vitamin-like cofactors in nutrition including chemical properties, absorption, metabolism, excretion and deficiency syndromes. A critical study of the biochemical basis of substances and of certain laboratory techniques.

NUSC 610 Readings in Nutrition. (1–3) Second semester. Prerequisites: NUSC 402 or NUTR 300, CHEM 461 or consent of instructor. One lecture, one 2 hour laboratory per week. Basic concepts of animal energetics with quantitative descriptions of energy requirements and utilization.

NUSC 612 Energy Nutrition. (2) Second semester. Prerequisites: NUSC 402 or 450, CHEM 461, or consent of instructor. One lecture, one 2 hour laboratory per week. Basic concepts of animal energetics with quantitative descriptions of energy requirements and utilization.

NUSC 614 Proteins. (2) Second semester. One lecture and one 2 hour laboratory per week. Prerequisites: NUSC 402 or NUTR 300, and CHEM 461 or consent of instructor. Advanced study of the roles of amino acids in nutrition and metabolism. Protein digestion, absorption, anabolism, catabolism and amino acid balance.

NUSC 620 Nutrition for Community Services. (3) First semester. Three lectures per week. Application of the principles of nutrition to community problems of specific groups. Students may select problems for independent study.

NUSC 663 Advanced Nutrition Laboratory. (3) Prerequisite: ANSC/NUSC 401 and either CHEM 462 or NUSC 670. One hour of lecture and six hours of laboratory per week. Basic instrumentation and techniques desired for advanced nutritional research. The effect of various nutritional parameters upon intermediary metabolism, enzyme kinetics, endocrinology, and nutrient absorption in laboratory animals.

NUSC 670 Intermediary Metabolism in Nutrition. (3) Second semester. Three lectures per week. Prerequisites: NUSC 402 or NUTR 300, CHEM 461 or 462. The major routes of carbohydrate, fat and protein metabolism with particular emphasis on metabolic shifts and their detection and significance in Nutrition.

NUSC 680 Human Nutritional Status. (3) First semester, alternate years. Methods of appraisal of human nutritional status, to include dietary, biochemical and anthropometric techniques.

NUSC 698 Seminar in Nutrition. (1–3) First and second semesters. A study in depth of a selected phase of Nutrition.

NUSC 699 Problems in Nutrition. (1–4)

NUSC 799 Master's Thesis Research. (1–6) First and second semesters. Work assigned in proportion to amount of credit. Students will be required to pursue original research in some phase of nutrition, carrying the same to completion, and reporting the results in the form of a thesis.

NUSC 898 Colloquium in Nutrition. (1) First and second semester. Oral reports on special topics or recently published research in Nutrition. Distinguished scientists are invited as guest lecturers. A maximum of three credits allowed for the M.S.

NUSC 899 Doctoral Dissertation Research. (1–8) First and second semesters. Work assigned in proportion to amount of credit. Students will be required to pursue original research in some phase of nutrition, carrying the same to completions, and reporting the results in the form of a dissertation.

Philosophy Program

Professor and Chairman: Gorovitz
Professors: Pasch, Perkins, Schlaretzki, Shapere, Svenonius
Associate Professors: Brown, Celarier, Darden, Greenspan, Johnson, Lesher, Martin, Stich, Suppe
Assistant Professors: Ahern, Hausman, Levine, Levinson, Odell, Stairs

The Department of Philosophy offers graduate programs leading to the M.A. and Ph.D. degrees, with emphasis on contemporary British and American philosophy and the bearing of philosophy on other disciplines. A person seeking the Ph.D. normally enters that program directly, without first pursuing the M.A. program (though the M.A. may be earned on the way to the Ph.D.). Whereas the Ph.D. program is suitable primarily for persons who wish to enter a career of teaching and research at the college or university level, the M.A. program is appropriate for persons who desire to deepen and expand the knowledge they gained as undergraduates or to develop competence in philosophy for the sake of its applications in some other professional field.

A special, interdisciplinary curriculum in the history and philosophy of science, in cooperation with the Department of History and under the supervision of the Committee on the History and Philosophy of Science, is also offered, at the M.A. and Ph.D. levels.

The Center for Philosophy and Public Policy, operating under the auspices of the Division of Behavioral and Social Sciences and the Division of Arts and Humanities engages in research, teaching, and curriculum development in the ethical and conceptual issues in public policy formation. The Center offers graduate students opportunities for course work and research.

The Department sponsors a series of colloquia by visiting and local speakers throughout the academic year.

Admission and Degree Information

The Department admits to the Ph.D. program only students intending to undertake full-time study toward that degree.

Students seeking admission to the Ph.D. program in philosophy should normally have completed, with a high grade average, at least eighteen semester hours (or the equivalent) of philosophy, including one course in logic, two courses in the history of philosophy, and two courses from among the following areas: ethics, epistemology, and metaphysics. The Graduate Record Examination Aptitude Test (verbal and quantitative sections) is required. Applications must be supported by two or three letters of recommendation from previous instructors, at least one of whom is familiar with the applicant's work in philosophy. The applicant is required also to submit a sample of his written work on a philosophical topic. The letters and paper, as well as the G.R.E. test scores, should be sent directly to the Department of Philosophy.

Students may be admitted to the curriculum in the history and philosophy of science with fewer than eighteen hours in philosophy provided that this is compensated for by a strong background in science. For details, consult the Chairperson, Committee on the History and Philosophy of Science.

Qualitative criteria for M.A. admission are substantially less stringent than for Ph.D. admission, but the same supporting documents must be provided.

The M.A. program may be pursued through either of two options: with thesis or without thesis. On either option candidates demonstrate competence in symbolic logic and knowledge of modern philosophy, There are no specific course requirements beyond the Graduate School requirements applicable to all M.A. degrees. Foreign language skills are required insofar as demanded by the individual student's research. To earn the M.A. without thesis a student must pass a written comprehensive examination and must submit a collection of papers demonstrating competence in philosophical research and writing.

In addition to satisfying Graduate School requirements applicable to all Ph.D. programs, students in the regular philosophy program are required to demonstrate competence by examination in two general areas—ethics and social and political philosophy; and metaphysics, epistemology, and philosophy of science—and subsequently to demonstrate competence, primarily by the writing of one or more papers, in some specialized area of philosophy. These demonstrations must be achieved within six semesters, during which time the student must register for full-time study. Other special requirements are: qualification in symbolic logic; fulfillment of certain course distribution requirements; participation in a departmental teaching seminar; and presentation of a research paper at a departmental colloquium. All Ph.D. students are required also to gain two semesters' experience in teaching undergraduates at an institution of higher learning, either by way of the Department's teaching assistantship program or some other program approved by the Department's Director of Graduate Studies.

Foreign language skills are required insofar as demanded by the individual student's research.

An accelerated Ph.D. program, having somewhat different requirements, for exceptionally promising and well-prepared students permits early concentration on the dissertation subject.

Philosophy students pursuing the Ph.D. curriculum in the history and philosophy of science are subject to certain special requirements: they demonstrate competence by examination, plus written papers, in (a) the history of science and the contemporaneous philosophies of science, and (b) the philosophy of science and related metaphysical and epistemological problems. The third area for demonstration of competence is either a field of science (for students not possessing an undergraduate science degree) or an area of philosophy. Course work must include courses in the history of science and technology, the philosophy of science, graduate-level courses in an area of science, a course on research methods in history and philosophy of science, and either Philosophy 471 or 478. In addition the student must demonstrate reading competency in a foreign language, normally French or German.

Financial Assistance

The Department administers a number of graduate assistantships. Well-prepared entering students have a good chance of receiving some financial support in the first year, and there is presumption in favor of reappointment through the fourth year.

Additional Information

Brochures describing the regular M.A. and Ph.D. programs in philosophy may be obtained by writing to the Committee on Graduate Admissions and Awards, Department of Philosophy. Information concerning the curriculum in the history and philosophy of science may be obtained from the Chairperson, Committee on the History and Philosophy of Science.

Courses

PHIL 408 Topics in Contemporary Philosophy. (3) Prerequisite: PHIL 320. An intensive examination of contemporary problems and issues. Source material will be selected from recent books and articles. May be repeated for credit when the topics dealt with are different.

PHIL 412 The Philosophy of Plato. (3) Prerequisites: PHIL 310 and 320. A critical study of selected dialogues.

PHIL 414 The Philosophy of Aristotle. (3) Prerequisites: PHIL 310 and 320. A critical study of selected portions of Aristotle's writings.

PHIL 416 Medieval Philosophy. (3) Prerequisites: PHIL 310 or 320. A history of philosophic thought in the west from the close of the Classical Period to the Renaissance. Based on readings of the Stoics, early Christian writers, Neoplatonists, later Christian writers, and schoolmen.

PHIL 421 The Continental Rationalists. (3) Prerequisites: PHIL 310 and 320. A critical study of the systems of some of the major 17th and 18th century rationalists, with special reference to Descartes, Spinoza, and Leibniz.

PHIL 422 The British Empiricists. (3) Prerequisites: PHIL 310 and 320. A critical study of selected writings of Locke, Berkeley, and Hume.

PHIL 423 The Philosophy of Kant. (3) Prerequisites: PHIL 310 and 320. A critical study of selected portions of Kant's writings.

PHIL 428 Topics in the History of Philosophy. (3) Prerequisites: PHIL 310 and 320, or consent of instructor. May be repeated for credit when the topics dealt with are different.

PHIL 438 Topics in Philosophical Theology. (3) Prerequisite: PHIL 236 or consent of instructor. An examination of a basic issue discussed in theological writings, with readings drawn from both classical and contemporary theologians and philosophers. May be repeated to a maximum of six credits when the topics are different.

PHIL 440 Ethical Theory. (3) Prerequisite: PHIL 140. Contemporary problems having to do with the meaning of the principal concepts of ethics and with the nature of moral reasoning.

PHIL 445 Political and Social Philosophy II. (3) Prerequisite: PHIL 140 or 345. A systematic treatment of the main philosophical issues encountered in the analysis and evaluation of social (especially political) institutions.

PHIL 447 Philosophy of Law. (3) Prerequisite: One course in philosophy. Examination of fundamental concepts related to law, e.g., legal system, law and morality, justice, legal reasoning, responsibility.

PHIL 450 Scientific Thought I. (3) The development of science, its philosophical interpretations and implications, and views of its methods, from the ancients through Newton and Leibniz.

PHIL 451 Scientific Thought II. (3) The development of science, its philosophical interpretations and implications, and views of its methods, from the death of Newton to the early twentieth century.

PHIL 452 Philosophy of Physics. (3) Prerequisites: PHYS 142, 263, or 294, or permission of instructor. Investigation of the implications of 20th-century physics for such problems as operationalism, the structure and purposes of scientific theories, the meaning of 'probability', the basis of geometrical knowledge, the Copenhagen interpretation of quantum mechanics, the nature and limits of measurement. Interaction between physics and philosophy will be stressed throughout.

PHIL 453 Philosophy of Science II. (3) Prerequisites: PHIL 250 or an upper-division course in Philosophy or a major in science or permission of the instructor. A comprehensive survey of developments in the main problems of Philosophy of Science from logical positivism to the present. The nature of theories, models, laws and counterfactuals, testing, inductive logic and confirmation theory, experimental methodology, measurement, explanation, concept formation, scientific change, and scientific realism.

PHIL 455 Philosophy of the Social Sciences. (3) Prerequisites: PHIL 250 or six hours in a social science or consent of the instructor. A consideration of philolophical issues arising in the social sciences, with particular emphasis on issues of practical methodological concern to social scientists.

PHIL 456 Philosophy of Biology. (3) Prerequisite: PHIL 250 or permission of the instructor. Questions about concepts, reasoning, explanation, etc., in Biology, and their relations to those of other areas of science. Case studies of selected aspects of the history of Biology, especially in the twentieth century.

PHIL 457 Philosophy of History. (3) An examination of the nature of historical knowledge and historical explanation, and of theories of the meaning of World History.

PHIL 458 Topics in the Philosophy of Science. (3) Prerequisite: PHIL 250 or consent of the instructor; when the topic for a given semester demands, additional philosophical or scientific prerequisites may be required by the instructor. A detailed examination of a particular topic or problem in philosophy of science. Repeatable to a maximum of six credits when the content is different.

PHIL 461 Theory of Meaning. (3) Prerequisites: PHIL 170 or 371, and 320. A study of theories about the meaning of linguistic expressions, including the verification theory and the theory of meaning as use. Among topics to be considered are naming, referring, synonymy, intension and extension, and ontological commitment. Such writers as Mill, Frege, Russell, Lewis, Carnap, Wittgenstein, Austin, and Quine will be discussed.

PHIL 462 Theory of Knowledge. (3) Prerequisites: PHIL 310 and 320. PHIL 371 is recommended. The origin, nature, and validity of knowledge considered in terms of some philosophic problems about perceiving and thinking, knowledge and belief, and language, truth and confirmation.

PHIL 464 Metaphysics. (3) Prerequisites: PHIL 310 and 320. PHIL 371 is recommended. A study of some central metaphysical concepts (such as substance, relation, causality, and time) and of the nature of metaphysical thinking.

PHIL 466 Philosophy of Mind. (3) Prerequisite: PHIL 320. An inquiry into the nature of mind through the analysis of such concepts as consciousness, perception, understanding, imagination, emotion, intention, and action.

PHIL 471 Symbolic Logic II. (3) Prerequisite: PHIL 371 or consent of instructor. Axiomatic development of the propositional calculus and the first-order functional calculus, including the deduction theorem, independence of axioms, consistency, and completeness.

PHIL 474 Induction and Probability. (3) Prerequisite: Consent of instructor. A study of inferential forms, with emphasis on the logical structure underlying such inductive procedures as estimating and hypothesis-testing. Decision-theoretic rules relating to induction will be considered, as well as classic theories of probability and induction.

PHIL 478 Topics in Symbolic Logic. (3) Prerequisite: PHIL 471. May be repeated for credit when the topics dealt with are different.

PHIL 498 Topical Investigations. (1–3)

PHIL 688 Selected Problems in Philosophy. (1–3) Prerequisite: Consent of instructor.

PHIL 788 Research in Philosophy. (1–6) Prerequisite: consent of chairman of tutorial-advisory committee. Repeatable to a maximum of 6 credits.

PHIL 799 Master's Thesis Research. (1–6)

PHIL 808 Seminar in the Problems of Philosophy. (3) Prerequisite: Consent of instructor.

PHIL 828 Seminar in the History of Philosophy. (3) Prerequisite: Consent of instructor.

PHIL 838 Seminar in Esthetics. (3) Prerequisite: Consent of instructor.

PHIL 848 Seminar in Ethics. (3) Prerequisite: Consent of instructor.

PHIL 868 Seminar in Metaphysics. (3) Prerequisite: Consent of instructor.

PHIL 869 Seminar in the Theory of Knowledge. (3) Prerequisite: Consent of instructor.

PHIL 899 Doctoral Dissertation Research. (1–8)

Physical Education Program

Professor and Chairman: Husman
Professors: Clarke, Dotson, Eyler, Humphrey, Ingram, Kelley, Kramer, Steel
Associate Professors: Church, Hult, Santa Maria
Assistant Professors: Arrighi, Craft[1], Dainis, Dummer, Morris, Murray, Phillips, Schmidt, Tyler, Vaccaro[1], VanderVelden, Wrenn

[1] joint appointment with Secondary Education

The graduate student majoring in Physical Education may pursue the degrees of Master of Arts or Doctor of Philosophy. The two major objectives of these programs are: (1) to study the discipline of physical education by examining the effects of physical activity on individuals from a physiological, kinesiological, psychological, social and historical point of view; and (2) to acquaint the student with curricular aspects of physical education, to improve the quality of teaching, and to offer the student ways of improving the administration and supervision of programs in schools and colleges.

The graduate program is organized into three divisions, offering major emphasis as follows: (1) Division of Sport Studies, including history of sport, psychology of sport, and sociology of sport; (2) Division of Biophysical Studies with specialties in physiology of exercise, motor learning and biomechanics; and (3) Division of Curricular Studies, with emphasis on curriculum-supervision-administration, teacher education, and adapted programs.

Admission and Degree Information

The basic minimum guideline for admission to the M.A. program in Physical Education is a B average or a 3.0 average for the last two years of undergraduate study, both in the major and related subject fields. Students not quite meeting these qualifications may be admitted provisionally. At least 18 semester credit hours in Physical Education must have been completed prior to admission into the Program. Undergraduate prerequisites for advanced study in Physical Education normally include history of physical education, physiology of exercise, kinesiology, adapted physical education, measurement and evaluation, motor learning and statistics. Students without these necessary courses may register as special students or be admitted provisionally with limited course deficiencies.

Admission to the Ph.D. program is secured upon the basis of satisfactory preparation for advanced graduate work and demonstrated potential for scholarly achievement. A B+ grade point average (3.5 on a 4.0 point scale) in previously taken graduate work, with at least a 3.0 overall average in the final two years of undergraduate study, is the scholastic standard for admission. In those cases where special qualifications are apparent from letters of recommendation and documentations of special backgrounds, but where the scholastic standards stated above are not met in their entirety, a student may be admitted on a provisional basis. Students on provisional status will have their work carefully reviewed by a graduate review committee usually within the first year for further classification.

The requirements for the M.A. in Physical Education (Thesis Option) are a minimum of 24 semester hours, exclusive of thesis. Six are required in the PHED specialty, with six additional PHED hours required. In addition, the following courses are required of all M.A. students majoring in physical education: PHED 610: Methods and Techniques of Research (3 semester hours); PHED 689Q, Intermediate Quantitative Methods (3 semester hours). The remaining six hours are to be taken outside the major department, in related courses intended to supplement and support the major work. The student is also required to register for six semester hours of thesis credits (PHED 799). Thus the total number of credit hours required for the degree is 30. Two years of full-time graduate study are usually required for completion of The Master's degree. The requirements for the M.A. in Physical Education (non-thesis option) are a minimum of 30 semester hours. Required courses include PHED 610 and a three hour research processes course which supports the major subject matter area. A minimum of six (6) credit hours must be taken in the PHED major specialty, with nine (9) additional PHED hours required. Six (6) credit hours must be taken outside the department in related courses, and a minimum of three (3) credit hours must be taken in PHED 689, Special Problems in Physical Education, involving independent work on a project under the direction of a Graduate Faculty member. The student must pass a final comprehensive examination.

The requirements for the Ph.D. degree consist of course work in the following areas: (1) a minimum of 12 hours in the area of specialization, (2) a minimum of 6 hours related to the candidate's area of research interest, and (3) a minimum of 15 hours in a related studies area selected from outside the Department. In some instances more credits may be required for completion of this requirement, which must consist of subject matter essential to support the dissertation topic. Courses completed may be taken within a single department or from several departments.

Students within all divisions of the Department must demonstrate competency in research. Commensurate with this competency is a basic understanding of the scientific method including the ability to apply logic and objectivity to the understanding of phenomena and the ability to formulate and test relevant hypotheses. Normally, competency in the scientific method includes demonstrating an understanding of (1) the research processes in physical education; (2) the quantitative methods of analysis employed in physical education research; and (3) the principles underlying the statistical aspects of experimental and non-experimental designs employed in physical education research.

Twelve hours is the minimum and eighteen the maximum allotted for the Ph.D. dissertation. (PHED 899).

No foreign language is formally required for the Ph.D. degree, although in certain situations it may be required by the advisor of students who are doing extensive reading in German, Spanish, French, Russian or some other language.

Facilities and Special Resources

The Department maintains a modern research laboratory for physical education, including, but not limited to, cinematographic analysis, cardiovascular measurement, strength and other motor fitness assessments, body composition, analysis of motion, and motor learning research. In addition, the new Physical Education, Recreation and Health building complex offers the graduate student access to research facilities including a small animal laboratory and a minicomputer based data acquisition system for real-time laboratory application which interfaces with the University Computer Science Center.

Financial Assistance

Each year a number of graduate assistantships are offered to men and women. Specific responsibilities include teaching in the activity program or assisting in the research laboratory.

Additional Information

For further information and application, contact David H. Clarke, Director of Graduate Studies, Department of Physical Education, University of Maryland.

Courses

PHYSICAL EDUCATION, RECREATION, AND HEALTH

PERH 487 Adult Health and Developmental Program. (3) Prerequisite: Consent of instructor. Training and experience in a clinically oriented development program for the aged.

PERH 488 Children's Health and Development Clinic (1–4) Prerequisite: Consent of instructor. An opportunity to acquire training and experience in a therapeutically oriented physical education–recreation program for children referred by various education, special education, medical or psychiatric groups. Repeatable to a maximum of 4 credits.

PERH 490 Theories of Children's Love and Peace Behavior (3) The development of love and peace behaviors as health correlates in infra human and human species from infancy through childhood with special emphasis upon the role of physical education, recreation, and health. The examination of existing models in the areas of family, school, and clinical settings.

PERH 689 Selected Problems in Health, Physical Education and Recreation. (1–6) Research projects in special areas in Health, Physical Education and/or Recreation which have interdisciplinary implications not covered in structured courses.

PHYSICAL EDUCATION

PHED 400 Kinesiology. (4) Three lectures and two laboratory hours a week. Prerequisites: ZOOL 101, 201, and 202 or the equivalent. The study of human movement and the physical and physiological principles upon which it depends. Body mechanics, posture, motor efficiency, sports, the performance of atypical individuals, and the influence of growth and development upon motor performance are studied.

PHED 401 Kinesiology for Dance. (3) Mechanical and anatomical components of human movement. Integration of the scientific knowledge necessary to the dancer with the artistic aspects of Dance. Practical experience in the application of kinesiological principles to Dance and Dance Education. May not be taken for credit by students who have credit in PHED 400.

PHED 406 Perceptual-Motor Development in the Young Child. (3) Analysis of perceptual-motor components, their progression, interrelationships, developmental activities and evaluation. Study of the growth and other factors that influence perceptual-motor development in the young child.

PHED 420 Physical Education for the Elementary School. (3) Orientation of the general elementary teacher to Physical Education. Principles and practices in Elementary Physical Education are discussed and a variety of appropriate activities are considered.

PHED 421 Elementary School Physical Education—A Movement Approach. (3) Prerequisites: PHED 183 and 184. An analysis of movement philosophy and content, focusing upon cognitive, psychomotor and affective developmental characteristics in relation to progression and planning of games, educational dance and educational gymnastices for elementary school age children.

PHED 451 Sport and the American Woman. (3) The expanding perception of the woman's role in American society; etiology of sex differences; socialization of sex roles in America; development of 'masculinity' and 'feminity' in children through early play experiences; competition and women; personality of the female athlete; and personal motivations of female athletes and projected future for sport and the American.

PHED 455 Physical Fitness of the Individual. (3) A study of the major physical fitness problems confronting the adult modern society. Consideration is given to the scientific appraisal, development, and maintenance of fitness at all age levels. Such problems as obesity, weight reduction, chronic fatigue, posture, and special exercise programs are explored. Open to persons outside the profession of Physical Education.

PHED 461 Exercise and Body Composition. (3) Prerequisites: CHEM 104, ZOOL 201, and ZOOL 202; or consent of instructor. Physiological concepts relating body composition factors to exercise and human performance. The scientific basis for the establishment and evaluation of conditioning programs where body composition may play an important role, such as weight control and athletics.

PHED 470 Seminar for Student Teachers. (2) A seminar held concurrently with student teaching in Physical Education. An intensive examination of current problems and issues in teaching Physical Education.

PHED 480 Measurement in Physical Education. (3) Two lectures and two laboratory periods a week. Prerequisite: MATH 105 or 110. A study of the principles and techniques of educational measurement as applied to teaching of Physical Education; study of the functions and techniques of measurement in the evaluation of student progress toward the objectives of Physical Education and in the evaluation of the effectiveness of teaching.

PHED 487 Physical Education and Sport in Contemporary Cultures. (3) Three lectures a week. Prerequisite: SOCY 100 or equivalent. A study of the cultural impact of Physical Education activities in the United States and selected countries. Individual research on selected topics is required.

PHED 489 Field Laboratory Projects and Workshop. (1–6) Workshops and research projects in special areas of knowledge not covered by regularly structured courses. Note: The maximum total number of credits that may be earned toward any degree in Physical Education is six.

PHED 490 Organization and Administration of Physical Education. (3) The application of the principles of administration and supervision to Physical

Education and Intramurals. Students are normally enrolled during the student teaching semester.

PHED 491 The Curriculum in Elementary School Physical Education. (3) Techniques planning and construction are considered from a standpoint of valid criteria for the selection of content in elementary school Physical Education. Desirable features of cooperative curriculum planning in providing for learning experiences will be presented and discussed

PHED 493 History and Philosophy of Sport and Physical Education. (3) History and philosophical implications of sport and physical education through ancient, medieval, and contemporary periods in Western Civilization.

PHED 495 Organization and Administration of Elementary School Physical Education. (3) Prerequisite: PHED 420. Studies the procedures basic to satisfactory organization of all phases of the elementary school Physical Education program. Emphasis is placed on the organizational and administrative factors necessary for the successful operation of the program in various types of elementary schools.

PHED 496 Quantitative Methods. (3) Statistical techniques most frequently used in research pertaining to Physical Education. Effort is made to provide the student with the necessary skills, and to acquaint him with the interpretations and applications of these techniques.

PHED 497 Independent Studies Seminar. (3) Discussions of contemporary issues vital to the discipline, critiques of research in the student's area/areas of special interest, completion of a major project where the student will be asked to demonstrate the ability to carry out investigative processes in problem solving and critical writing under faculty direction.

PHED 498 Special Topics in Physical Education. (3) Prerequisite: Consent of instructor. Topics of special interest in areas not covered by regularly scheduled courses. Repeatable when the subject matter is different.

PHED 600 Seminar in Physical Education. (1)

PHED 602 Status and Trends in Elementary School Physical Education. (3) Analyzes the current status and implications for future trends in Physical Education at the elementary school level. Open to experienced persons in all phases of Education.

PHED 604 Physical Education and the Development of the Child. (3) Analyzes the place of Physical Education in meeting the growth and developmental needs of children of elementary school age.

PHED 606 Perceptual Motor Development through Movement. (3) A study of the development of perceptual-motor skills through directed physical activities. An investigation of the growth and development of perceptual-motor programs. Analysis of common factors and differences between selected programs and philosophies. Evaluation in perceptual-motor development.

PHED 610 Methods and Techniques of Research. (3) Studies methods and techniques of research used in Physical Education an analysis of examples of their use; and practice in their application to problems of interest to the student.

PHED 612 Research Literature. (3) Studies the research literature of Physical Education, plus research in one specific problem.

PHED 615 Principles and Techniques of Evaluation. (3) Prerequisite: An introductory course in measurement or permission of the instructor. A study of currently used means of evaluating the performance of students and the effectiveness of programs of Physical Education in schools and colleges. Specific problems concerning evaluation, brought in by members of the class, will be analyzed.

PHED 620 Analysis of Contemporary Athletics. (3) Studies current problems, practices, and national issues of permanent importance to the conduct of athletic competition in a democracy.

PHED 630 Sociology of Sport in Contemporary Perspective. (3) Studies social organization and the role of individuals and groups in sport situations: the interrelationship of sport with traditional social institutions; sport as a sub-system and its structure; and sport and social problems.

PHED 640 Supervisory Techniques in Physical Education. (3) Studies current concepts, principles and techniques of supervision and of their application; observation of available supervising programs, including visits with local supervisors; and practice in the use of selected techniques.

PHED 642 Administrative Direction of Physical Education. (3) Analyzes administrative problems in the light of sound educational practice. Students concentrate their efforts upon their own on-the-job administrative problems and contribute to the solution of other class members' problems.

PHED 644 Curriculum Construction in Physical Education. (3) Studies the principles underlying curriculum construction in Physical Education and the practical applications of these principles to the construction of a curriculum.

PHED 650 Mental and Emotional Aspects of Sports and Recreation. (3) Prerequisites: Psychology and/or Human Development. An exploration of psychological aspects of Physical Education, sports and recreation, including personality dynamics in relation to exercise and sports. A study is made of the psychological factors in athletic performance and coaching.

PHED 660 Philosophy of Physical Education. (3) Studies five important philosophical disciplines and their impact on modern Physical Education and sport; and an exploration of the valid philosophical approaches and processes to formulation of a personal philosophy of Physical Education.

PHED 661 Philosophy of Sport. (3) An examination of the meaning and significance of the phenomena of sport. The influence of the major philosophical points of view as related to modern physical activity and sport in the American society. An exploration of the valid philosophical approaches and processes to the formulation of a philosophy of sport. Exploration and inquiry into the interpretations of facts, meanings, and values in sport.

PHED 662 History of Sport in Western Culture. (3) Prerequisites: PHED 493 or equivalent and 12 hours in upper division level courses involving Western culture. A history of sport of the early and medieval periods.

PHED 663 History of Sport in Western Culture. (3) Prerequisites: PHED 493 or equivalent and 12 hours in upper division level courses involving Western culture. A history of sport of the Renaissance and Modern Periods.

PHED 670 Biomechanics Theory. (3) Prerequisites: MATH 141 or 221 or equivalent. Theoretical basis for the understanding the investigation of biomechanical aspects of the human body. Integration of subject matter from physics, engineering, anatomy, kinesiology, and physiology as it relates to the study of human motion and the body as a mechanical system.

PHED 680 Therapeutic Exercise. (3) Prerequisites: PHED 460 or permission of instructor. A current, critical analysis of the role of exercise as a therapeutic modality in treating muscular-skeletal, neuromuscular and sensory disorders; nutritional disorders and obesity; emotional and stress related disturbances; and degenerative disease and aging.

PHED 685 Advanced Motor Learning. (3) Prerequisite: PHED 485 or equivalent. A research-oriented approach to motor learning, including instrumentation and laboratory experimental techniques in motor learning research. Major topics covered are motor learning theories, information processing, motor memory, proprioceptive control of movement, and feedback.

PHED 688 Seminar in Motor Learning and Performance. (3) Prerequisites: PHED 485 and 496. Discussion of research dealing with advanced topics in motor learning and skilled performance. Recent developments concerning individual differences, refractoriness, anticipation and timing, transfer, retention, and work inhibition are emphasized. May be repeated for a total of 6 hours.

PHED 689 Special Problems in Physical Education. (1–6) Master or doctoral candidates who desire to pursue special research problems under the direction of their advisor may register for 1–6 hours of credit under this number.

PHED 690 Scientific Bases of Exercise. (3) Prerequisites: Anatomy, physiology, PHED 400, 460, or equivalent. A critical analysis of the role of physical exercise in modern society with attention given to such topics as: the need for physical exercise, its chronic effects, the role of exercise in attaining good physical condition and fitness, factor determining championship performances, and physical fatigue.

PHED 691 Muscular Aspects of Exercise Physiology. (3) Prerequisite: PHED 460 or equivalent. Muscular aspects of exercise physiology, including sensory and mechanical factors controlling contraction. Emphasis on the study of muscular fatigue, strength development and hypertrophy, the metabolic and nutritional factors affecting physical performance, and the cellular events associated with exercise and training.

PHED 692 Cardiovascular Aspects of Exercise Physiology. (3) Prerequisite: PHED 460 or equivalent. A comprehensive consideration of the various cardiovascular factors affecting human physical performance. Emphasis on the regulation of cardiovascular functions during physical activity. Energy liberation and transfer, circulation, respiration, temperature regulation, physiology of work at altitudes, aerobic endurance training, and exercise, health and aging.

PHED 770 Advanced Biomechanics. (3) Prerequisites: PHED 670; CMSC 103 or equivalent. The application of scientific methods to problems in Human Biomechanics. Instrumentation for data collection and measurement, mechanical models of the body and their mathematical treatment, and current research topics.

PHED 775 Advanced Analysis of Human Motion. (3) Prerequisites: PHED 400, 460, College Algebra or equivalent of by permission of instructor. A research-oriented kinesiological analysis of human movement as it relates to sports and the activities of daily living. The analysis is accomplished by means of various measurement procedures including cinematography, electronic timing devices and similar instruments.

PHED 789 Advanced Seminar. (1–3) Studies the current problems and trends in selected fields of Physical Education.

PHED 799 Master's Thesis Research. (1–6)

PHED 899 Doctoral Dissertation Research. (1–8)

Physics Program

Professor and Chairman: Park
Professors: Alley, Anderson, Banerjee, Bhagat, Brill, Currie, DeSilva, Dorfman[3], Dragt, Earl, Falk, Ferrell[3], Glasser, Glick, Gloeckler, Glover, Gluckstern, Greenberg, Griem, Griffin, Hendrie, Holmgren, Hornyak, Howarth, Korenman, Y. C. Lee, Liu, MacDonald, Marion, Misner, Oneda, Ott, Papadopoulos, Pati, Prange, Redish, Reiser[2], Roos, Slawsky, Snow, Steinberg, Sucher, Toll, Weber, Woo, Yodh, B.S. Zorn, G.T. Zorn
Adjunct Professors: Bennett, Friedman, Hayward, McDonald, Rado
Associate Professors: Bardasis, Boyd, C.Y. Chang, Chant, Drew, Fivel, Goldenbaum, Kacser, Kim, Layman[4], Lynn Richard, Roush[1], Wallace
Adjunct Associate Professor: Dixon, Pechacek
Assistant Professors: Bagchi, Breuer, Caswell, C.C. Chang, H.H. Chen, Dombeck, Dworzecka, Einstein, Ellis, Mason, Paik, Skuja, Wang, Wickes

[1] Joint appointment with Chemical Engineering
[2] Joint appointment with Electrical Engineering
[3] Joint appointment with Institute for Physical Science and Technology
[4] Joint appointment with Secondary Education

The Department of Physics and Astronomy has active programs in several areas of current research. Those in astronomy are listed under the heading of Astronomy. Those in the physics program include: astrophysics, atomic physics, chemical physics, elementary particle theory, fluid dynamics, general relativity, high energy physics, many-body theory, molecular physics, nuclear physics, particle accelerator research, plasma physics, quantum electronics and optics, quantum field theory, solid state physics, space physics, and statistical mechanics.

Admission and Degree Information

The Graduate Record Examination (GRE Advanced) is recommended, and the average GRE score for admission is 750. A minimum overall score of 500 on the Test of English as a Foreign Language is required of applicants from non-English speaking countries.

Because of the large number of qualified applicants, the Department of Physics and Astronomy has had to restrict formal admission to the Graduate School to those who have shown particularly outstanding work in their undergraduate records, or who have already done satisfactory work in key senior-level courses at the University of Maryland. Students who have less outstanding records but who, because of exceptional circumstances, show special promise may be given provisional admission, with regular admission pending the satisfactory completion of existing deficiencies. Each student so admitted will be informed by an assigned departmental advisor what background he is lacking, and what he must accomplish to achieve regular admission. The University of Maryland hopes in this way to offer an opportunity for advanced study in physics and astronomy to all qualified students.

Entering graduate students are normally expected to have strong backgrounds in physics, including courses in the intermediate level in mechanics, electricity and magnetism, thermodynamics, physical optics, and modern physics. A student with deficiencies in one or more of these areas may be admitted, but will be expected to remedy such deficiencies as soon as possible.

The Department offers both thesis and non-thesis M.S. programs. The departmental requirements for the non-thesis option include at least four courses of the general physics sequence, PHYS 601, 602, 604, 606, 622 and 623, plus the graduate lab, PHYS 621, unless specifically exempted; a research paper as evidence of ability to organize and present a written scholarly report on contemporary research; the passing at the master's level of one section of the Ph.D. qualifying exam; and the passing of a final oral examination.

The requirements for the Master of Science degree with thesis include at least four courses of the general physics sequence plus, for students presenting a theoretical thesis, the graduate laboratory unless specially exempted; and the passing of an oral examination including a defense of thesis.

The requirements for the Ph.D. in Physics are set in general terms to allow the individual student as much freedom as possible in preparing a course of study suited to individual needs. These requirements are: competence in basic physics indicated by satisfactory performance on a Qualifying Examination and in the Graduate Laboratory; a research paper as evidence of ability to organize and present a written scholarly report on contemporary research prior to candidacy; advanced course study outside the student's field of specialization consisting of at least two courses (6 credits) in physics at 700 or 800 level and two courses (6 credits) recognized for graduate credit given outside the physics program (this may include astronomy); PHYS 624 or 625 for students with theoretical theses; and research competence through active participation in at least two hours of seminar, 12 hours of thesis research and the presentation and defense of an original dissertation.

Facilities and Special Resources

The current research in the Department spans an immense range of theoretical and experimental work on the forefront of knowledge, far too large to describe here. For details of the work in the various fields, the faculty and the facilities involved, the Department annually puts out a booklet entitled "Research in Physics and Astronomy," which may be obtained upon request.

To give some idea of the magnitude of the program we note that of the professional faculty of 84, there are 71 engaged in separately budgeted research; faculty members at other ranks likewise engaged in research number 64. In 1979–80, 80 graduate students also have participated in research, under stipends. The current federal support for research amounts to approximately nine million dollars annually, attesting to both the size and the quality of the program.

The Department houses the Center for Theoretical Physics, which provides a means for outstanding theoretical physicists to visit the Department as postdoctoral fellows and visiting faculty members.

There are close academic ties with the Institute of Physical Science and Technology on the campus; members of this institute supervise graduate research and share in the teaching of physics courses. The Department also has close ties with the University's Computer Science Center, which provides outstanding computer facilities for the University.

In addition to using College Park campus facilities, graduate students can, under certain conditions, utilize resources of nearby federal laboratories.

The University of Maryland is located within the metropolitan area of Washington, D.C., where it enjoys the proximity of a large number of outstanding institutions such as NASA's Goddard Space Flight Center, the Naval Research Laboratory, the Naval Surface Weapons Center, the National Bureau of Standards, the Johns Hopkins Applied Physics Laboratory, the Department of Energy, the National Institutes of Health, the Library of Congress, and other Federal Institutions. The Department has close ties with certain research groups at some of these institutions. In order to facilitate graduate study in the Washington area, the Department of Physics and Astronomy has part-time professors in certain government laboratories.

Students desiring to do graduate work in physics at a government agency should contact a member of the graduate faculty in the Department.

Financial Assistance

The Department offers both teaching and research assistantships. In 1979–80 there were about 75 of each. Summer research stipends for advanced graduate students are customary, and a few summer teaching assistantships are available.

The deadline for applications for financial support and assistantships is March 1; for fellowships the deadline is February 1.

Graduate students also can seek full-time or part-time employment in the many government and industry laboratories located within a few miles of the campus.

Additional Information

Three booklets are available regarding the graduate programs in Astronomy and in Physics. "Graduate Study in Physics and Astronomy: is a guidebook to procedural requirements and rules concerning the acquisitions of higher degrees. "Research Physics and Astronomy 1978–79" describes the graduate research activities and lists the personnel involved, group by group. It gives the names of faculty and graduate students involved in various research projects, together with brief descriptions of those projects. "Graduate Programs in Physics and Astronomy" is a publication which lists faculty and research projects; it also provides basic information for prospective students inquiring about the College Park programs in astronomy and physics.

In addition, twice yearly, a comprehensive memorandum is issued regarding the course offerings and academic program for the current calendar year. The memorandum issued in April describes the program beginning in late August; the November memorandum describes the spring semester programs.

Regarding admission or for further information write Mrs. Jean Clement, Secretary, Graduate Entrance Committee, Department of Physics, University of Maryland.

Courses

PHYS 400 Basic Concepts of Physics I. (3) Prerequisite: Junior standing. A primarily descriptive course in two semesters, intended mainly for those students in the liberal arts who have not had any other course in physics. This course does not serve as a prerequisite or substitute for other physics courses. The main emphasis is on the concepts of physics, their evolution and their relation to other branches of human endeavor.

PHYS 401 Basic Concepts of Physics II. (3) Prerequisite, PHYS 400 or consent of instructor.

PHYS 404 Intermediate Theoretical Mechanics. (3) Prerequisites: PHYS 142 or 263; MATH 241 previously or concurrently. Fundamentals and selected advanced topics of physical mechanics. Vector differential calculus will be used.

PHYS 405 Intermediate Theoretical Electricity and Magnetism. (3) Prerequisite: PHYS 142 or 263; MATH 241. Intermediate electricity and magnetism and electromagnetic waves (optics). Vector differential calculus is used throughout.

PHYS 406 Optics. (3) Three lectures a week. Prerequisites: PHYS 263 or 284 and MATH 240, or consent of instructor. Geometrical optics, optical instruments, wave motion, interference and diffraction, and other phenomena in physical optics.

PHYS 407 Sound. (3) (Will be given only with sufficient demand.) Prerequisite: PHYS 122, 142 or 263. MATH 240 is to be taken concurrently.

PHYS 410 Elements of Theoretical Physics—Mechanics. (4) Prerequisites: PHYS 284, or PHYS 404 and 405, or PHYS 263 and consent of instructor, and also MATH 241. A study of the theoretical foundations of mechanics, with extensive applications of the methods. Also various mathematical tools of theoretical physics.

PHYS 411 Elements of Theoretical Physics—Electricity and Magnetism. (4) Prerequisite: PHYS 404 or 410, and PHYS 263 or 284 or 405, or consent of the instructor. A study of the foundations of electromagnetic theory, with extensive application of the methods. Thorough treatment of wave properties of solutions of Maxwell's Equations.

PHYS 412 Kinetic Theory of Gases. (3) Prerequisites: PHYS 404 and 405 or PHYS 410 and MATH 240 or equivalent. Dynamics of gas particles, Maxwell-Bultzmann Distribution, diffusion, Brownian Motion, etc..

PHYS 414 Introduction to Thermodynamics and Statistical Mechanics. (3) Prerequisites: MATH 240, PHYS 284 or 404 or consent of the instructor. Introduction of basic concepts in thermodynamics and statistical mechanics.

PHYS 420 Modern Physics for Engineers. (3) Prerequisites: PHYS 263 or 284 or 404 and 405; MATH 241 or consent of instructor. A survey of atomic and nuclear phenoma and the main trends in modern physics. This course is appropriate for students in Engineering and other physical sciences. It should not be taken in addition to PHYS 421.

PHYS 421 Introduction to Modern Physics. (3) Prerequisites: PHYS 284 or equivalent; MATH 241 including some knowledge of ordinary differential equations. Introductory discussion of special relativity, origin of quantum theory, Bohr Atom, wave mechanics, atomic structure, and optical spectra.

PHYS 422 Modern Physics. (3) Prerequisite: PHYS 421. This course uses the basic ideas of quantum

mechanics and special relativity to discuss the characteristics of many diverse subjects including complex atoms, molecules, solids, nuclei and elementary particles.

PHYS 423 Elementary Quantum Physics. (3) Prerequisites: PHYS 420 or 421, MATH 246; and a level of mathematical sophistication equivalent to that of a student who has taken PHYS 410 and 411, or ENEE 380 and 382. The quantum theory is presented in a rigorous way including the concepts of operators, measurement and angular momentum. These concepts together with the Schroedinger equation are then applied to some basic problems in atomic and molecular physics.

PHYS 429 Atomic and Nuclear Physics Laboratory. (3) PHYS 395 and consent of instructor. Classical experiments in atomic physics and more sophisticated experiments in current techniques in nuclear physics.

PHYS 431 Properties of Matter. (3) Prerequisite: PHYS 404 and 405 or PHYS 410 or PHYS 420 or PHYS 421 Introduction to solid state physics. Electromagnetic, thermal, and elastic properties of metals, semiconductors and insulators.

PHYS 441 Nuclear Physics. (3) Prerequisite: PHYS 404 and 405; or PHYS 410; or PHYS 420; or PHYS 421. An introduction to nuclear physics at the pre-quantum-mechanics level. Properties of nuclei; radioactivity; nuclear systematics; nuclear moment; the shell model, interaction of charged particles and gamma rays with matter; nuclear dectectors; accelerators; nuclear reactions; beta decay; high energy phenomena.

PHYS 443 Neutron Reactor Physics. (3) Prerequisite: PHYS 420 or PHYS 421 or consent of instructor. Various related topics in neutron reactor physics.

PHYS 451 Introduction to Elementary Particles. (3) Prerequisite: PHYS 422 or consent of instructor. Properties of elementary particles, production and detection of particles, relativistic kinematics, invariance principles and conservation laws.

PHYS 461 Introduction to Fluid Dynamics. (3) Prerequisites: PHYS 404 and MATH 240. Kinematics of fluid flow, properties of incompressible fluids, complex variable methods of analysis, wave motions.

PHYS 463 Introduction to Plasma Physics. (3) Three lectures a week. Prerequisites: PHYS 404 or 410, or ENES 221; and PHYS 405 or 411, or ENEE 380; or consent of instructor. Students without the electricity and magnetism prerequisite but having a familiarity with Maxwell's equations should check with the instructor. Orbit theory, magneto-hydrodynamics, plasma heating and stability, waves and transport processes.

PHYS 465 Modern Optics. (3) Prerequisites: PHYS 401 and 420 or 421, and 411 or consent of the instructor. Designed for students with a background in fundamental optics, the course deals with topics in modern optics such as coherence, holography, principles of laser action, electron optics, and non-linear optics.

PHYS 471 Introduction to Atmospheric and Space Physics. (3) Prerequisite: PHYS 404 and 405 or 410, 420 or 421. Motions of charged particles in magnetic fields, aspects of plasma physics related to cosmic rays and radiation belts, atomic phenomena in the atmosphere, thermodynamics and dynamics of the atmosphere.

PHYS 483 Biophysics and Theoretical Biology. (3) Prerequisite: consent of the intructor. Designed for advanced and mature students who may have only minimal knowledge of biological processes but are well grounded in physics. Areas in bioscience where physics, biophysical chemistry, and mathematical analysis fuse to provide definition for biologic statics and dynamics.

PHYS 485 Electronic Circuits. (4) Three hours of lecture and two of laboratory per week. Prerequisite: PHYS 395, and concurrent enrollment in PHYS 405 or 411. Theory of semi-conductor and vacuum tube circuits. Application in experimental physics.

PHYS 487 Particle Accelerators, Physical and Engineering Principles. (3) Prerequisites: PHYS 410, 411 or 271, 321 and 421, or equivalents. Sources of charged particles, methods of acceleration and focusing of electron and ion beams in electromagnetic fields; electrostatic accelerators; constant-gradient cyclotrons and synchrotrons; betatrons and microtrons; the alternating-gradient and sector-focusing principles; isochronous cyclotrons and alternating-gradient sychrotrons; linear accelerators. This course is also listed as ENEE 487.

PHYS 490 History of Modern Physics. (3) Prerequisite: PHYS 420 or 421 or equivalent. Primarily for senior physics majors and first year graduate students. A survey of major discoveries and trends in 20th Century physics, including the relations of physics to other sciences, philosophy of science, technology and society.

PHYS 499 Special Problems in Physics. (1–16) Prerequisite, major in physics and consent of advisor. Research or special study. Credit according to work done.

PHYS 601 Theoretical Dynamics. (3) Prerequisite: PHYS 410 or equivalent. Lagrangian and Hamiltonian mechanics, two-body central force problem, rigid body motion, small oscillations, continuous systems.

PHYS 602 Statistical Physics. (3) Prerequisite: PHYS 410 or equivalent. Statistical mechanics, thermodynamics, kinetic theory.

PHYS 604 Methods of Mathematical Physics. (3) Prerequisite: advanced calculus, PHYS 410 and 411, or equivalent. Ordinary and partial differential equations of physics, boundary value problems, Fourier series, Green's functions, complex variables and contour integration.

PHYS 606 Electrodynamics. (4) Prerequisite: PHYS 604 or equivalent. Classical electromagnetic theory, electro- and magnetostatics, Maxwell equations, waves and radiation, special relativity.

PHYS 621 Graduate Laboratory. (3) Six hours of laboratory work per week. Design and performance of advanced experiments in modern and classical physics.

PHYS 622 Introduction to Quantum Mechanics I. (4) First and second semesters. Prerequisite: an outstanding undergraduate background in physics. A study of the Schroedinger equation, matrix formulations of quantum mechanics, approximation methods, scattering theory etc., and applications to solid state, atomic, and nuclear physics.

PHYS 623 Introduction to Quantum Mechanics II. (3) First and second semesters. Prerequisite, an outstanding undergraduate background in physics. A study of the Schroedinger equation, matrix formulations of quantum mechanics, approximation methods, scattering theory etc., and applications to solid state, atomic, and nuclear physics. Continuation of PHYS 622.

PHYS 624 Advanced Quantum Mechanics. (3) Prerequisite, PHYS 623. Relativistic wave equations, second quantization in many body problems and relativistic wave equations, Feynman-Dyson perturbation theory, applications to many body problems, application to quantum electrodynamics, elements of renormalization.

PHYS 625 Non-Relativistic Quantum Mechanics. (3) Prerequisite: PHYS 623. Non-relativistic second quantization, single particle Green's function, perturbation theory, linked cluster expansion, Feynman and Goldstone diagrams; applications to imperfect Fermi gases; superconductivity.

PHYS 686 Charged Particle Dynamics, Electron and Ion Beams. (3) Prerequisites: PHYS 410, 411 or PHYS 271, 321 or consent of instructor. Three hours per week. General principles of single-particle dynamics; analytical and practical methods of mapping electric and magnetic fields; equations of motion and special solutions; Liouville's theorem; electron optics; space charge effects in high current beams; design principles of special electron and ion beam devices. This course is also listed as electrical engineering 686.

PHYS 703 Thermodynamics. (3) Prerequisite: PHYS 602. The first and second laws of thermodynamics are examined and applied to homogeneous and non-homogeneous systems, calculations of properties of matter, the derivation of equilibrium conditions and phase transitions, the theory of irreversible processes.

PHYS 704 Statistical Mechanics. (3) Prerequisites: PHYS 411 and 602. A study of the determination of behavior of matter from microscopic models. Microcanonical, canonical, and grand canonical models. Applications of solid state physics and the study of gases.

PHYS 708 Seminar in Teaching College Physics. (1)

PHYS 709 Seminar in General Physics. (1)

PHYS 711 Symmetry Problems in Physics. (3) Prerequisite: PHYS 623. A study of general methods of classification of physical systems by their symmetries and invariance properties, especially in quantum field theory applications.

PHYS 718 Seminar in General Physics. (1)

PHYS 719 Seminar in General Physics. (1)

PHYS 721 Theory of Atomic Spectra. (3) Prerequisite: PHYS 622. A study of atomic spectra and structure, one and two electron spectra, fine and hyper-fine structure, line strengths, line widths, etc.

PHYS 722 Theory of Molecular Spectra. (3) Prerequisite: PHYS 721. The structure and properties of molecules as revealed by rotational, vibrational, and electronic spectra.

PHYS 723 Molecular Physics I. (2) Prerequisite: PHYS 623. The fundamentals of the interpretation of the spectra of simple molecules with particular attention to quantitative considerations. Emphasis on topics generally regarded as falling outside the domain of molecular structure, notably the measurement and analysis of molecular spectroscopic line intensities.

PHYS 724 Molecular Physics II. (2) Two lectures per week. Prerequisite: PHYS 623. The fundamentals of the interpretation of the spectra of simple molecules with particular attention to quantitative considerations. Emphasis on topics generally regarded as falling outside the domain of molecular structure, notably the measurement and analysis of molecular spectroscopic line intensities. Continuation of PHYS 723.

PHYS 728 Seminar in Atomic and Molecular Physics. (1)

PHYS 729 Seminar in General Quantum Mechanics and Quantum Electronics. (1)

PHYS 731 Solid State Physics—Survey. (3) A variety of topics such as crystal structure, mechanical, thermal, electrical, and magnetic properties of solids, band structure, the semi-surface, and superconductivity will be treated. Although the emphasis will be on the phenomena, the methods of quantum mechanics are freely employed in this description.

PHYS 738 Seminar in Experimental Solid State Physics. (1)

PHYS 739 Seminar in Theoretical Solid State Physics. (1)

PHYS 741 Nuclear Structure Physics—Survey. (3) Prerequisite: PHYS 623. Properties of the nucleon-nucleon interaction, systematics of nuclear stable states, theory of nuclear matter, shell model and Hartree-Fock theory of nuclear states, rpa (random-phase-approximation) and pairing correlations, collective states of deformed nuclei, electromagnetic transitions, beta decay of nuclear states.

PHYS 742 Nuclear Reaction Theory: Survey. (3) Prerequisite: PHYS 623. General scattering theory, direct reaction theories for elastic and inelastic processes, resonance reaction theories of Bloch and Feshbach, shell model approach to reaction theory, statistical theories of compound nuclear processes, multiple scattering theory, heavy ion reactions.

PHYS 748 Seminar in Experimental Nuclear Physics. (1)

PHYS 749 Seminar in Theoretical Nuclear Physics. (1)

PHYS 751 Elementary Particle Physics I—Survey. (3) Three lectures a week. Co-requisite: PHYS 624 or consent of the instructor. Nuclear forces are studied by examining interactions at high energies. Meson physics, scattering processes, and detailed analysis of high energy experiments.

PHYS 752 Elementary Particle Physics II: Theory. (3) Prerequisite: PHYS 624 and 751 or consent of the instructor. Survey of elementary particles and their properties, quantum field theory, meson theory, weak interactions, possible extensions of elementary particle theory.

PHYS 758 Seminar in Elementary Particles and Quantum Field Theory. (1)

PHYS 759 Seminar in Elementary Particles and Quantum Field Theory. (1)

PHYS 761 Plasma Physics I—Survey. (3) Prerequisite: PHYS 604, 606 or consent of instructor. A detailed study of plasma physics. The first semester

treats particle orbit theory, magnetohydrodynamics, plasma waves, and transport phenomena.

PHYS 762 Plasma Physics II. (3) Continuation of PHYS 761. Vlasov theory, including waves, stability, and weak turbulence, kinetic equation theories of correlations and radiative processes.

PHYS 768 Seminar in Fluid Dynamics. (1)

PHYS 769 Seminar in Plasma Physics. (1)

PHYS 771 Cosmic Ray Physics: Survey. (3) Pre- or co-requisite: PHYS 601 or consent of instructor. Interaction of cosmic rays with matter, geomagnetic cutoffs, origin and propagation of cosmic rays, the electron component and its relationship to cosmic radio noise; experimental methods.

PHYS 778 Seminar in Space and Cosmic Ray Physics. (1)

PHYS 779 Seminar in General Relativity. (1)

PHYS 788 Seminar in Applied Physics. (1)

PHYS 789 Seminar in Interdisciplinary Problems. (1)

PHYS 798 Special Problems in Advanced Physics. (1–3) Projects or special study in Advanced Physics.

PHYS 799 Master's Thesis Research. (1–6)

PHYS 808 Special Topics in General Physics. (1–4) Prerequisite: Consent of instructor. Credit according to work done.

PHYS 809 Special Topics in General Physics. (1–4) Prerequisite: Consent of instructor. Credit according to work done.

PHYS 818 Special Topics in General Physics. (1–4) Prerequisite: Consent of instructor. Credit according to work done.

PHYS 819 Special Topics in General Physics. (1–4) Prerequisite: Consent of instructor. Credit according to work done.

PHYS 828 Special Topics in Atomic and Molecular Physics. (1–4) Prerequisite: Consent of instructor. Credit according to work done.

PHYS 829 Special Topics in Quantum Mechanics and Quantum Electronics. (1–4) Prerequisite: Consent of instructor. Credit according to work done.

PHYS 832 Theory of Solids I. (3) Prerequisite: PHYS 623, co-requisite, PHYS 624. Advanced topics in the quantum theory of solids from such fields as band structure calculations, optical properties, phonons, neutron scattering, the dynamics of electrons in one-band theory, the Landau-Fermi Liquid Theory, charged Fermi liquids, the Fermi surface (surface impedance, cyclotron resonance, the De Hass-Van Alphen Effect, etc.).

PHYS 833 Theory of Solids II. (3) Continuation of PHYS 832. Covers special topics such as magnetism, superconductivity and electron-phonon interactions.

PHYS 838 Special Topics in Experimental Solid State Physics. (1–4) Prerequisite: Consent of instructor. Credit according to work done.

PHYS 839 Special Topics in Theoretical Solid State Physics. (1–4) Prerequisite: Consent of instructor. Credit according to work done.

PHYS 843 Theoretical Nuclear Physics I. (3) Prerequisite: PHYS 624. Three lectures a week. Nuclear properties and reactions, nuclear forces, two, three, and four body problems, nuclear spectroscopy, Beta decay, and related topics.

PHYS 844 Theoretical Nuclear Physics II. (3) Continuation of PHYS 843. Nuclear properties and reactions, nuclear forces, two, three, and four body problems, nuclear spectroscopy, Beta decay, and related topics.

PHYS 848 Special Topics in Experimental Nuclear Physics. (1–4) Prerequisite: Consent of instructor. Credit according to work done.

PHYS 849 Special Topics in Theoretical Nuclear Physics. (1–4) Prerequisite: Consent of instructor. Credit according to work done.

PHYS 851 Advanced Quantum Field Theory. (3) Prerequisite: PHYS 624. Renormalizations of LaGramgian Field Theories, Lamb Shift, positronium fine structure, T. C. P. Invariance, connection between spin and statistics, broken symmetries in many body problems, soluble models, analyticity in perturbation theory, simple applications of dispersion relations.

PHYS 852 Theoretical Methods in Elementary Particles. (3) Prerequisite or co-requisite: PHYS 851.

PHYS 853 Quantum Field Theory. (3) Co-requisite: PHYS 851. Introduction to Hilbert Space, general postulates of relativistic quantum field theory, asymptotic conditions, examples of local field theory, Jost-Lehmann-Dyson representation and applications, generalized free field theory, general results of local field theory-TCP theorem, spin statistics connections, Borchers' Theorems, Reeh-Schlieder Theorem.

PHYS 858 Special Topics in Elementary Particles and Quantum Field Theory. (1–4) Prerequisites: PHYS 851 and PHYS 752. First semester.

PHYS 859 Special Topics in Elementary Particles and Quantum Field Theory. (1–4) Prerequisite: Consent of instructor. Credit according to work done.

PHYS 862 Controlled Fusion Physics and Technology. (3) Prerequisite: PHYS 761. Review of fusion plasma physics, followed by high voltage pulse technology, ion sources, high power lasers; magnetic and inertial confinement schemes major 'matches' in controlled thermonuclear research.

PHYS 863 Plasma Equilibrium, Stability and Transport Properties. (3) Prerequisite: PHYS 762 or equivalent. Applications of magnetohydrodynamics and kinetic theory to the equilibrium, stability and transport properties of magnetically confined high temperature plasmas.

PHYS 864 Nonlinear Effects and Radiation Processes in High-Temperature Plasmas. (3) Prerequisite: PHYS 762. Advanced survey of fundamental nonlinear effects and radiation processes in high-temperature plasmas.

PHYS 868 Special Topics in Fluid Dynamics. (1–4) Prerequisite: Consent of instructor. Credit according to work done.

PHYS 869 Special Topics in Plasma Physics. (1–4) Prerequisite: Consent of instructor. Credit according to work done.

PHYS 875 Theory of Relativity: Survey. (3) Prerequisite: PHYS 601. A brief survey of Einstein's Special Theory of Relativity followed by a solid introduction to general relativity and its applications.

PHYS 878 Special Topics in Space and Cosmic Ray Physics. (1–4) Prerequisite: Consent of instructor. Credit according to work done.

PHYS 879 Special Topics in General Relativity. (1–4) Prerequisite: consent of instructor. Credit according to work done.

PHYS 888 Special Topics in Applied Physics. (2)

PHYS 889 Special Topics in Interdisciplinary Problems. (1–4) Prerequisite: consent of instructor. Credit according to work done.

PHYS 899 Doctoral Dissertation Research. (1–8)

Poultry Science Program

Professor and Chairman: Thomas
Professor Emeritus: Shaffner
Professor: Heath
Associate Professors: Johnson, Kuenzel, Soares
Assistant Professors: Doerr, Ottinger
Adjunct Professor: Byerly

Coursework and research activities leading to the Master of Science and the Doctor of Philosophy degrees are offered by the Department of Poultry Science. The student may pursue work with major emphasis in either nutrition, physiology, physiological genetics, or the technology of eggs and poultry.

Departmental requirements, supplementary to those of the Graduate School, have been formulated for the guidance of candidates for graduate degrees. Copies of these requirements may be obtained from the Department of Poultry Science.

Courses in these programs are listed elsewhere under the headings Animal Science, Nutritional Sciences, and Food Science, as appropriate.

Facilities and Special Resources

The Department has excellent facilities for both broilers and layers. The laboratories are well equipped with equipment such as amino acid analyzer, atomic absorption spectrophotometer, gas chromatography, Technician auto-analyzer, Instron Food Analyzer, Grass polygraph, Leitz Dialux microscope, liquid scintillation system; Aminco-Bowman spectrophotoflurometer; liquid chromatograph etc.

Financial Assistance

Graduate research assistantships and teaching assistantships are available in the Department.

Psychology Program

Professor and Chairman: Gross
Professors: Anderson, Bartlett, Crites, Dies, Fretz, Goldstein, Gollub, Hodos, Horton, Levison, Locke[2], Magoon[1], Martin, McIntire, Mills, D.[1], Mills, J., Pumroy[1], Scholnick, Sigall, Steinman, Taylor, Trickett, Tyler
Associate Professors: Brown, Coursey, Freeman[1], Gelso[1], Hill, Larkin, Norman, Penner, Smith, B., Sternheim
Assistant Professors: Bobko, Brauth, Gormally, Johnson, Smith, K., Soli, Steele, White

[1]joint appointment with Counseling and Personnel Services
[2]joint appointment with Business and Management

The Department of Psychology offers training leading to the degrees of Master of Arts, Master of Sciences, and Doctor of Philosophy. By Departmental ruling, the number of graduate students is limited to a ratio of four resident students per member of the Graduate faculty, insuring close and intimate contact in research and seminars.

Training for the Master of Arts and Master of Science degrees differs in the relative emphasis on content in the social and biological sciences. Programs leading to the Doctor of Philosophy degree are offered in the areas of clinical, counseling, experimental, industrial, applied developmental psychology, quantitative, and social psychology. The experimental area is further subdivided into three fields of study: biopsychology; human learning and psycholinguistics; and sensory and perceptual processes. Many fields have a range of subspecialties (e.g., engineering psychology) in which the student may concentrate. The Department's doctoral programs in both Clinical and Counseling Psychology have been approved by the American Psychological Association.

Admission and Degree Information

The Department accepts as graduate students only those who have demonstrated superior aptitude and appear capable of completing the requirements for the doctoral degree. All of the specialty areas offer doctoral level programs; they do not accept students who are interested in terminal M.A. degrees. The average scores of students admitted for the 1976–77 academic year were GRE V+Q 1200, GRE Psychology 600, G.P.A. 3.5; Psychology G.P.A. 3.7. The Department of Psychology encourages applications from minority groups and women.

Applicants are encouraged to submit applications by February of each year for entrance in

the fall as the available spaces are usually filled early.

For a doctoral degree a minimum of 72 hours beyond the B.A. is required. All students entering with a B.A. are required to take two courses in statistics and five courses in areas outside their specialty program. Of these five courses, three must be core courses chosen from a group of available courses designed to provide basic information in a variety of specialty areas. The other two courses may be advanced seminars of additional core work.

The remaining credit hours (approximately 50 hours) are devoted to research and course work in the participant's specialty program. If the student chooses to have a second specialty, the two advanced courses specified above along with one core course may be taken in one coherent area to provide a second specialty.

While the course of study in the Department of Psychology is at the doctoral level, most students choose to earn the M.A. or M.S. degree en route to the Ph.D. The M.A. or M.S. degree requirements are thirty hours of work including the two courses in statistics, two core courses and one other course which may be an additional core offering or advanced seminar. A research thesis is also required. Advancement to the third and fourth year of doctoral level work is based upon satisfactory completion of core courses, work in the student's specialty area and completion of a research requirement.

Facilities and Special Resources

The Department moved into a new building during the summer of 1971, and new facilities were designed by the faculty of the Department of Psychology for the training of graduate students. In addition, its geographic location in a suburb of Washington, D.C. makes accessible a wide variety of laboratory and training facilities in governmental and other agencies, as well as many psychologists prominent in the profession.

Financial Assistance

The Department gives financial aid to almost all incoming students. The Department of Psychology does not offer a part-time program. Students are required to attend classes, take part in research and teach as graduate assistants. Each of these assignments is considered a critical part of the graduate training program. It is not possible to obtain this type of education on a part-time basis. Thus, students are not permitted to hold off-campus jobs unless they are under the direct supervision of the faculty.

Additional Information

Additional information concerning the graduate program including specific program brochures and application materials may be obtained by writing professor Irwin L. Goldstein, Director of Graduate Studies, Department of Psychology, University of Maryland.

Courses

PSYC 400 Experimental Psychology—Learning and Motivation. (4) Prerequisites: PSYC 200 and either 206 or 301. Two lectures and four one-hour laboratory periods per week. Primarily for students who major in Psychology. The experimental analysis of behavior with emphasis on conditioning, learning and motivational processes. Experiments are conducted on the behavior of animals.

PSYC 401 Advanced Laboratory in the Experimental Analysis of Behavior. (3) Prerequisite: PSYC 400. An intensified extension of the principles and techniques demonstrated in the laboratory of PSYC 400. Emphasis on complex schedules of reinforcement, and experimental designs using repeated measures.

PSYC 402 Physiological Psychology. (3) Prerequisite: PSYC 206 or 301. An introduction to research on the physiological basis of human behavior, including considerations of sensory phenomena, motor coordination, emotion, drives, and the neurological basis of learning.

PSYC 403 Animal Behavior. (3) Prerequisite: PSYC 206 or 301. A study of animal behavior, including considerations of social interactions, learning, sensory processes, motivation, and experimental methods, with a major emphasis on mammals.

PSYC 404 Introduction to Behavioral Pharmacology. (3) Prerequisite: Psychology 400 or permission of instructor. This course surveys the basic findings and theoretical viewpoints on the interaction of drugs and behavior. Topics include an introduction to basic principles of pharmacology, the effects of drugs on various behavior, experimental analysis of drug dependence and abuse, and neuropharmacology and behavior.

PSYC 405 Applied Behavior Analysis. (3) Prerequisite: PSYC 301. Theoretical and research literature in the application of operant and respondent conditioning principles to human behavior. Approaches to behavior problems in school, home and professional settings.

PSYC 410 Experimental Psychology—Sensory Processes I. (4) Three lectures and one two-hour laboratory/demonstration period per week. Prerequisite: MATH 140, or 111 and 220. Primarily for students who major in Psychology. A systematic survey of the content, models, and methodologies of sensory and perceptual research. A student who has completed PSYC 310 must have permission of the instructor in order to register for PSYC 410.

PSYC 412 Experimental Psychology—Sensory Processes II. (4) Two lectures and four hours of laboratory exercise and research per week. Prerequisite: PSYC 410 or consent of instructor. Primarily for Psychology majors and majors in biological sciences with a special interest in sensory processes. Lectures and laboratory exercises will emphasize contemporary problems in sensory process research. Sufficient latitude will be provided so the exceptional student may conduct original research based on findings reported in the current literature.

PSYC 420 Experimental Psychology—Social Processes I. (4) Prerequisite: PSYC 200 and 221. Primarily for Psychology majors. A laboratory course which provides a basic understanding of experimental method in Social Psychology and experience in conducting research on social processes.

PSYC 421 Experimental Psychology: Social Processes II (4) Prerequisite: PSYC 420. Two hours of lecture and four hours of laboratory per week. An advanced laboratory course which provides intensive training in experimental work in social psychology and the opportunity to design and carry out original research on social processes.

PSYC 422 Language and Social Communication. (3) Prerequisite: PSYC 420. The nature and significance of verbal and nonverbal communication in social psychological processes including examination of relevant theoretical approaches to symbolic behavior.

PSYC 423 Advanced Social Psychology. (3) Prerequisite: PSYC 420. A systematic review of research and points of view in regard to major problems in the field of Social Psychology.

PSYC 431 Abnormal Psychology. (3) Prerequisite: PSYC 100, 200, and 400 or 410 or 420. The nature, diagnosis, etiology, and treatment of mental disorders. A student may not receive credit for both PSYC 331 and 431.

PSYC 433 Advanced Topics in Child Psychology. (3) Prerequisite: PSYC 200, 335. The growth and transformation of basic psychological processes from birth to maturity. Emphasis is on research data and methodological issues, especially as they relate to other aspects of Psychology. A student may not receive credit for both PSYC 333 and 433.

PSYC 435 Personality. (3) Prerequisite: PSYC 200, 331, and 400 or 410 or 420. Major personality theories, their postulates and evidence, assessment and research methodology in personality, major areas of personality research, their methodologies, findings, implications, and relationships to the field of Psychology. A student may not receive credit for both PSYC 335 and 435.

PSYC 436 Introduction to Clinical Psychology. (3) Prerequisites: PSYC 451; Either PSYC 431 or 435; and either PSYC 400 or 410 or 420. A survey and critical analysis of clinical psychology, with particular emphasis on current developments and trends. Designed to broaden the student's perspective on clinical psychology, to increase his intrinsic interest in the field, and to provide him with a firmer basis for critical evaluation of major theoretical and methodological foundations in the field. Students will be expected to conduct individual projects related to the course with a substantial amount of direct supervision.

PSYC 440 Introduction to Cognitive Psychology. (3) Prerequisite: PSYC 200. This course serves as an introduction to selected topics and theories in Cognitive Psychology. Topics include visual and auditory information processing, attention, memory, concept identification and psycholinguistics.

PSYC 441 Psychology of Human Learning. (3) Prerequisite: PSYC 200 and 440 or 410 or 420. Review and analysis of the major phenomena and theories of human learning, including an introduction to the fields of problem solving, thinking and reasoning.

PSYC 451 Principles of Psychological Testing. (4) Three lectures and one two-hour laboratory period per week. Prerequisite: PSYC 200 or equivalent. A survey of the basic concepts and theories of psychological measurement illustrated through demonstration of principal approaches to psychological testing.

PSYC 452 Psychology of Individual Differences. (3) Prerequisite: PSYC 200. Problems theories and researches related to psychological differences among individuals and groups.

PSYC 453 Mathematical Psychology. (3) Prerequisite: PSYC 200 or equivalent, and consent of instructor. A survey of mathematical formulations in Psychology, including measurement and scaling models, statistical and psychometric models, and elementary mathematical representations of psychological processes in learning, choice, psychophysics, and social behavior.

PSYC 460 Psychological Foundations of Personnel Selection and Training (3) Prerequisite: PSYC 200 or equivalent. An examination of issues and processes involved in the design and evaluation of personnel selection and training programs in a variety of organizational settings: job, person and organizational analysis; organizational choice; development of predictors; evaluation of instructional and training systems; criteria for performance evaluation, promotion and training.

PSYC 462 Engineering Psychology and Training Models. (3) Prerequisite: PSYC 200 or equivalent, and one other 200 level course. For majors. An examination of the theories and research regarding human performance capabilities and skills (information processing, decision-making, environmental constraints, automation), training procedures (traditional methods, programmed learning, computer-assisted instruction) and models and procedures for evaluating training programs in industry, education, and service organizations.

PSYC 463 Psychology of Motivation and Attitudes in Organizational Settings (3) Prerequisite: PSYC 361 or equivalent. Theories, research and practice regarding the assessment, understaning, and prediction of motivation at work. Theories of, and the assessment and consequences of, various work-related attitudes. An intergration of theory, research and practice.

PSYC 464 Psychology of Leaders in Work Organizations (3) Prerequisite: PSYC 361 or equivalent. The psychologial assumptions and implications of various theories of management and leadership. Selections and training; development of careers; influence processes; change of managenal behavior; and the impact of the larger environment, nature of product or service, and organization structure on managenal behavior.

PSYC 465 Psychology of Organizational Processes (3) Prerequisite: PSYC 361 or equivalent. Various theories of interpersonal, intra- and inter-group relations, with emphasis on issues of conflict, competition, cooperation and the role of power in organizations. Organizational diagnosis and intervention.

PSYC 466 Environmental and Ecological Psychology (3) Prerequisite: PSYC 200 or equivalent. An examination of measurement, description, and impact of the physical and social environments which affect various aspects of behavior in school, at work, and during leisure.

PSYC 467 Vocational Psychology. (3) Survey and critical analysis of theory and research on vocational

choice and vocational adjustment. Definition and correlates of vocational aspirations, preferences, choices, motivation, success, and satisfaction. Developmental trends in career decision-making and career patterns.

PSYC 468 Field Experience and Special Assignments in Honors. (1–3) Prerequisite: Supervisor and Honors Faculty approval. An individual experience arranged by the honors student and his or her supervisor. A proposal submitted to the Honors Faculty in the semester preceding registration for the course should state the activities anticipated and the method of evaluation.

PSYC 469 Honors Thesis Proposal Preparation. (1–3) Prerequisite: Honors thesis supervisor's approval. Development of honors thesis proposal by preliminary research and literature review. Presentation of formal proposal to the thesis committee. Repeatable to a maximum of 3 credits.

PSYC 470 Comprehensive Review for Honors Students. (3) Prerequisite: Honors Faculty approval. This course provides students with senior review guided by the Honors Faculty for preparation and completion of the honors examination.

PSYC 478 Independent Study in Psychology. (1–3) Prerequisite: Written consent of instructor. A student who wishes to take independent research study must have completed 12 hours of Psychology with at least A 2.5 average. Integrated reading under direction leading to the preparation of an adequately documented report on a special topic. (In special cases a student who may need to repeat this course in order to complete his independent study will make a formal request, including a research proposal, through his advisor to the departmental honors committee.)

PSYC 479 Special Research Problems in Psychology. (1–3) Prerequisite: Written consent of instructor. A student who wishes to take independent research study must have completed 12 hours of Psychology with at least a 2.5 average. An individual course designed to allow the student to pursue a specialized research topic under supervision. (In special cases a student who may need to repeat this course in order to complete his research will make a formal request, including a research proposal, through his advisor to the departmental honors committee.)

PSYC 488 Advanced Psychology I (Honors). (3) H—Honors. Usually taken during junior year. Prerequisites: PSYC 200 and permission of department honors committee. Seminar covering topics in sensation, perception, learning, and motivation.

PSYC 489 Senior Seminar. (3)

PSYC 498 Advanced Psychology II (Honors). H—Honors. Usually taken during senior year. Prerequisite: PSYC 488H. Semester covering topics in measurement, social processes and other subject matter of current interest.

PSYC 499 Honors Thesis Research. (3) H—Honors. Usually taken during last semester in residence. Prerequisite: Permission of thesis advisor.

PSYC 601 Quantitative Methods. (3) Prerequisite: PSYC 200 or equivalent. A basic course in mathematical formulations and quantitative analysis in Psychology, with an emphasis on measurement, probability, statistical inference and estimation, regression, and correlation.

PSYC 602 Quantitative Methods. (3) Prerequisite: PSYC 200 or equivalent. A basic course in mathematical formulations and quantitative analysis in Psychology, with an emphasis on measurement, probability, statistical inference and estimation, regression, and correlation.

PSYC 611 Advanced Developmental Psychology. (3) Empirical, experimental and theoretical literature related to developmental processes.

PSYC 612 Theories of Personality. (3) Scientific requirements for a personality theory. Postulates and relevant research literature for several current personality theories.

PSYC 619 Clinical Research Team. (1–3) Discussion of research topics; presentation and critique of original research proposals in Clinical Psychology. May be repeated to a maximum of six credits.

PSYC 640 Fundamentals of Social Psychology. (3) Method, research and theory in Social Psychology.

PSYC 651 Sensory and Perceptual Processes. (3) A broad coverage of knowledge in sensory and perceptual processes. Major theories and antecedents of contemporary research in the field.

PSYC 661 Experimental Analysis of Behavior. (3) Fundamental principles and theoretical framework of the experimental analysis of behavior.

PSYC 671 Advanced Topics in Human Learning. (3) A systematic review of major topic areas in the general field of human learning with particular emphasis upon learning, memory, and linguistic processes.

PSYC 678 Seminar in Psycholinguistics. (3) Prerequisite: PSYC 671. Contemporary psycholinguistic theories of language acquisition and use. Phonological, semantic and syntactic aspects of language. Repeatable to a maximum of six credits.

PSYC 679 Seminar in Cognitive Development. (3) Prerequisite: PSYC 611 or 671. Advanced coverage of research methodology and research issues in various areas of cognitive development such as discrimination learning, concept identification, form perception, language acquisition, and memory. Emphasis on interrelationships among developmental changes during infancy and childhood. Utility of a developmental perspective in analyzing the components of cognition. Repeatable to a maximum of six credits.

PSYC 687 Historical Viewpoints and Current Theories in Psychology. (3) Prerequisite: PSYC 622.

PSYC 688 Historical Viewpoints and Current Theories in Psychology. (3)

PSYC 701 Multivariate Analysis I. (3) Prerequisite: PSYC 602 or permission of instructor. Fundamentals of maxtrix algebra, multivariate distributions, multivariate estimation problems and test of hypotheses, general linear model.

PSYC 702 Multivariate Analysis II. (3) Prerequisite: PSYC 701 or permission of instructor. Component and factor analysis with emphasis on the appropriateness of the models to psychological data. Both theoretical issues and research implications will be discussed. The course will treat the factor analytic model, the three indeterminant problems of communalities, factor loadings, and factor scores, extraction algorithms, rotational algorithms, and the principal component model.

PSYC 703 Scaling Techniques and Theory. (3) Prerequisite: PSYC 602 or consent of instructor. Theory of measurement as applied to Psychology; and the associated experimental techniques needed to construct measurement scales. The principal psychophysical and psychometric scaling models are discussed.

PSYC 704 Test Theory. (3) Prerequisite: PSYC 602 or permission of instructor. A survey of theories of test construction with emphasis on reliability, validity, and criteria problems. Covers measurement in differential psychology, item analysis, reliability, validity, reliability of difference scores, prediction and the construction of test batteries, and factor theory.

PSYC 705 Mathematical Models of Learning and Memory. (3) Prerequisite: PSYC 602 or consent of instructor. Topics to be covered include a review of basic probability theory; matrix operations and difference equations; stochastic models of learning, memory and attention; stimulus sampling theory; computer simulations of learning processes.

PSYC 706 Seminar in Prediction. (3) Prerequisite: PSYC 602 or permission of instructor. In-depth review of techniques for prediction in the behavioral sciences. Emphasis on both theoretical rationale and research implications.

PSYC 707 Theory of Decision and Choice. (3) Prerequisite: PSYC 602 or consent of instructor. A study of algebraic and probabilistic models for decision and choice behavior, and related experimental procedures. Topics include: measurement of preference, utility and subjective likelihood models for certain and uncertain outcomes, normative strategies, competitive strategies, and group decision-making.

PSYC 708 Seminar in Psychometric Theory. (3) Prerequisite: PSYC 602 or consent of instructor. Study of the current practices, trends, or recent developments in psychometric theory. Repeatable to a maximum of nine hours.

PSYC 709 Seminar in Mathematical Models. (3) Prerequisite: PSYC 602 or consent of instructor. Special topics in Mathematical Psychology. A discussion of quantitative representations of psychological processes in one or more substantive areas of psychology. Repeatable to a maximum of nine hours.

PSYC 711 Introduction to Counseling Psychology. (3) Prerequisite: Permission of instructor. Introduction to the professional field, examination of pertinent scientific and philosophical backgrounds, and survey of the major theories, principles, and training models in counseling. Correlated laboratory analogue experiences in dyadic and group interrelationships.

PSYC 712 Principles and Procedures of Counselor Functions. (3) Prerequisite: PSYC 711. Specific functions and areas of specialization of the counseling psychologist including Vocational Psychology, use of tests in counseling, and student ecology. Principles of consultation, interprofessional relations, and ethical standards. Concurrent correlated laboratory experiences for all topics.

PSYC 713 Fundamentals of Clinical Psychology. (3) Prerequisite: Consent of the instructor. Analysis of Clinical Psychology as a scientist—professional paradigm, its historical roots and its scientific and professional evolution; selected coverage of current major research topics, e.g., psychotherapy, psychopathology, community; current nature of clinical psychology and evolving trends.

PSYC 718 Research Issues in Clinical, Counseling, and Community Psychology. (3) Prerequisite: Permission of instructor. Issues and strategies in conceptual systems, designs and methodologies of current research in these areas; critical analysis of current research. May be repeated to a maximum of nine credits.

PSYC 719 Seminar in Clinical, Counseling, and Community Psychology. (3) Prerequisite: Permission of instructor. Advanced selected topics in areas such as psychotherapy, consultation, assessment, psychopathology, student ecology, etc. May be repeated to a maximum of nine credits.

PSYC 721 Seminar and Laboratory in Behavioral Assessment I. (2) Prerequisite: Consent of instructor. PSYC 721 and 722 must be taken concurrently. Introduction to a broad range of assessment approaches, issues, theories and research. Emphasizes formulation and evaluation of strategies for information gathering and problem solving in a variety of clinical situations and includes behavioral observations, rating procedures and standardized tests.

PSYC 722 Seminar and Laboratory in Behavioral Assessment I. (2) Prerequisite: Consent of instructor. PSYC 721 and 722 must be taken concurrently. Introduction to a broad range of assessment approaches, issues, theories and research. Emphasizes formulation and evaluation of strategies for information gathering and problem solving in a variety of clinical situations and includes behavioral observations, rating procedures and standardized tests.

PSYC 723 Seminar and Laboratory in Behavioral Assessment II. (2) Prerequisite: Consent of instructor. PSYC 723 and 724 must be taken concurrently. Introduction to a broad range of assessment approaches, issues, theories and research. Emphasizes formulation and evaluation of strategies for information gathering and problem solving in a variety of clinical situations and includes behavioral observations, rating procedures and standardized tests.

PSYC 724 Seminar and Laboratory in Behavioral Assessment II. (2) Prerequisite: Consent of instructor. PSYC 723 and 724 must be taken concurrently. Introduction to a broad range of assessment approaches, issues, theories and research. Emphasizes formulation and evaluation of strategies for information gathering and problem solving in a variety of clinical situations and includes behavioral observations, rating procedures and standardized tests.

PSYC 727 Introductory Counseling Practicum. (3) Prerequisite: PSYC 711 and 712. Supervised training in application of methods relevant to behavior change through counseling.

PSYC 728 Introductory Didactic-Practicum in Psychological Intervention. (3) Prerequisite: Permission of instructor. Introduction to concepts and skills of psychological intervention emphasizing the relationship to the behavioral science foundation theories, methods and research findings with the development and utilization of intervention skills. The course includes supervised experience in intervention skills as designated by the subtopics of the course. May be repeated to a maximum of nine credits.

PSYC 729 Advanced Didactic-Practicum in Psychological Intervention. (3) Prerequisite: Consent of instructor and PSYC 727 or 728. Concept, research and supervised experience in intervention skills in advanced specialized areas, e.g., college student counseling, child evaluation, parent and school consultation, psychoevaluation, behavioral therapy, individual psychotherapy. May be repeated to a maximum of nine hours.

PSYC 730 Introduction to Industrial and Organizational Psychology. (3) Advanced survey of Industrial-Organizational Psychology, including selection, training, human engineering, motivation, group processes, leadership, organizational psychology, and some topics in research methods including philosophy of science. Readings stressed and seminar time will be used for discussion and integration of the reading materials. Various faculty members will serve as content experts.

PSYC 731 Training Procedures and Evaluation in Organizational Settings. (3) Psychological principles and methods in the development and evaluation of training procedures in business and industry, government and military, and educational and service institutions. Included are discussions of learning foundations, and training methodology (simulators, programmed instruction, computer-assisted instruction). The focus of the course is the design of evaluation research in social settings.

PSYC 732 Selection and Classification Issues in Organizations. (3) Prerequisite: PSYC 730, PSYC 601–602 or the equivalents, or permission of the instructor. Consideration of societal, organizational and individual demands for appropriate use of individual differences in (primarily) initial placement of employees. Recruitment, and selection issues, the role of governmental regulations, and the role of individual factors in individual behavior are considered. Extensive coverage given to fundamental psycho-metric problems and the development of individual and organizational criteria of effectiveness.

PSYC 733 Organizational Psychology. (3) Prerequisite: PSYC 730, PSYC 601–602 or their equivalents or permission of the instructor. Emphasizes theories and data regarding the impact of environmental factors on individual, group, and organizational behavior. Group dynamics, leadership, and power, motivation and satisfaction, and organization structure and environment are examined as correlates of behavior.

PSYC 734 Motivation and Attitudes in Organizations. (3) Prerequisite: Permission of the instructor. Major theories of human motivation in organizational contexts. Included will be theories concerning some determinants of performances, satisfaction and dissatisfaction, the relationship between satisfaction and performance, determinants of boredom and fatigue, and the functions and effects of incentives.

PSYC 735 Seminar in Human Performance Theory. (3) Prerequisite: Permission of the instructor. An examination of man-machine interaction with emphasis on the theories and research which focus on human performance capabilities and skills. Some of the topics covered are information processing and communications, decision making, environmental constraints and automation.

PSYC 738 Seminar in Industrial Psychology. (3) An advanced seminar covering specialized topics such as: morale and motivation, labor relations, consumer motivations, man-machine systems, quantitative and qualitative personnel requirements inventory, job evaluation, environment conditions and safety, occupational choice and classification, and the interview.

PSYC 740 Social Psychology Research Methodology. (3) A review of research methodology in Social Psychology, including research design, techniques of data collection, and the interpretation of data. Emphasis is placed on developing skill in evaluating studies and generating research designs

PSYC 741 Attitude Change. (3) A review of research and theory concerning the nature of attitudes and the determinants of attitude change.

PSYC 742 Group Behavior. (3) A review of research and theory concerning group behavior, including topics such as problem solving, communication, leadership and conformity.

PSYC 743 Person Perception. (3) A review of research and theory concerning the attribution of personal characteristics, interpersonal attraction and self-evaluation.

PSYC 748 Seminar in Social Psychology. (3) A seminar on selected topics in Social Psychology. Repeatable to a maximum of six credits.

PSYC 749 Current Research in Social Psychology. (1–3) Repeatable to a maximum of 9 credits.

PSYC 758 Seminar in Vision. (3) Prerequisite: PSTC 651 or consent of instructor. Selected topics in vision. Repeatable to a maximum of six credits.

PSYC 759 Seminar in Auditory Mechanisms. (3) Prerequisite: PSTC 651 or consent of instructor. Selected topics in auditory and psychoacoustic research, with emphasis on sensory and perceptual phenomena and their physiological bases. Repeatable to a maximum of six credits.

PSYC 761 Advanced Laboratory Techniques. (1–3) Methodology of the automatization or research techniques and apparatus; apparatus design and construction; telemetric and digital techniques; logical block circuitry.

PSYC 762 Comparative Psychology. (3) Prerequisite: PSYC 661. The experimental literature on the behavior of infra-human organisms. Special topics.

PSYC 763 Advanced Psychophysiology. (3) Alternate years.

PSYC 764 Comparative Neuroanatomy. (3) Prerequisites: A graduate or undergraduate course in physiological psychology or physiology or comparative anatomy or permission of instructor. Demonstrations and lectures on the gross, microscopic and ultrastructural morphology of the central nervous system of vertebrates.

PSYC 765 Seminar in Psychopharmacology. (3) Prerequisite: One year of graduate study in Psychology and consent of the instructor. A critical review and detailed analysis of the literature and problems related to the effects of drugs on animal and human behavior. Designed for advanced graduate students in Experimental Psychology and Clinical Psychology.

PSYC 766 Laboratory Methods in Neuroanatomy. (3) Permission of the instructor. Laboratory practice in the perfusion and fixation of neural tissue. Training in the use of the compound microscope, the microprojector, the reconstruction of brain lesions and macro- and microphotography of neural tissue.

PSYC 768 Conditioning and Learning. (3) Alternate years. Prerequisite: PSYC 622. The literature on the experimental analysis of behavior, with examination of basic experiments and contemporary theories related to them.

PSYC 778 Seminar in Learning and Memory. (3) Prerequisite: PSYC 671. An advanced topical seminar covering the areas of human learning and memory. Acquisition processes, storage and retrieval processes, and attention and information processing. Repeatable to a maximum of six credits.

PSYC 788 Special Research Problems. (1–4) Supervised research on problems selected from the area of experimental, industrial, social, quantitative, or mental health psychology.

PSYC 789 Special Research Problems. (1–4)

PSYC 798 Graduate Seminar. (2)

PSYC 799 Master's Thesis Research. (1–6)

PSYC 818 Research Issues in Personality or Development. (3) Prerequisites: PSYC 601, 602 and either 611 or 612 or their equivalents, depending on course content. Experimental design and methodology and statistical treatment of data appropriate to personality or developmental research; critical analysis of major current areas of research including methodologies, findings and implications. The course will focus on either personality research or developmental research in a given semester. May be repeated to a maximum of nine hours.

PSYC 819 Seminar in Personality and Development. (3) An advanced seminar covering specialized topics. Repeatable to a maximum of nine credits.

PSYC 858 Contemporary Theories in Sensory Processes. (3) Prerequisites: PSYC 651 or consent of instructor. Specialized study of sensory processes with emphasis on mathematical models. Repeatable to a maximum of six credits.

PSYC 859 Special Topics in Perception. (3) Prerequisites: PSYC 651 or consent of instructor. Intensive study of selected topics in perception. Repeatable to a maximum of six credits.

PSYC 878 Current Research in Language and Cognition. (3) Prerequisite: PSYC 671. Seminar will cover current research and methodological issues in language and cognition. Specialized topics include: computer models of cognitive behavior; cross-cultural studies in language and thought; mathematical and analytical techniques for assessing structures; and others. Repeatable to a maximum of six credits.

PSYC 888 Research Methods in Psychology. (1–3)

PSYC 889 Research Methods in Psychology. (1–3)

PSYC 898 Graduate Seminar. (2)

PSYC 899 Doctoral Dissertation Research. (1–8)

Public Communication Program

Professor and Director: Roger Meersman
Professors: Aylward[1], Meersman, Pugliese, Wolvin (Communication Arts and Theatre); Grunig, Hiebert, Martin[2], Merrill (Journalism)
Associate Professors: Falcione, Freimuth, Jamieson, Kirkley, Kolker, Linkow, O'Leary, Weiss, G.S. (Communication Arts and Theatre); Beasley, Levy (Journalism)
Assistant Professors: Cline, Conger, duMonceau, McCaleb, McCleary, Patterson, Philport, Thompson (Communication Arts and Theatre); Name, Nunamaker, McElreath (Journalism)

[1] Chairman, Department of Communication Arts and Theatre
[2] Acting Dean, College of Journalism

The Department of Communication Arts and Theatre and the College of Journalism offer a program leading to the Ph.D. in Public Communication. The program is interdisciplinary in nature, embracing the three divisions of Communication Arts and Theatre: radio-television-film, speech communication, and theatre and the College of Journalism; the Ph.D. prepares students for creative scholarship and research and emphasizes both the necessary techniques and skills to conduct research and the ability to think innovatively about problems of public communication. Areas of specialization within the program include political and governmental communication; public relations and organizational communication; international communication; science and medical communication; rhetoric and public address; broadcast communication; theatrical theory and aesthetics; theatre history, and cinema history and aesthetics.

Admission and Degree Information

Students may apply for admission to the Ph.D. in Public Communication program either through the College of Journalism or the Department of Communication Arts and Theatre.

The student in the Ph. D. program in Public Communication develops an individualized course of study in consultation with his/her doctoral committee, after considering the needs of the student and the specialized resources of the program faculty and of the Washington metropolitan area. The typical doctoral student will complete 20 courses beyond the Baccalaureate degree. To insure the interdisciplinary nature of the degree, at least one course must be taken from each of the four areas of the program: journalism, radio-television-film, speech communication, and theatre. The majority of the courses, however, will be in the student's area of specialization and in areas of study outside the program that enhance the individual's research capability.

The minimum requirements for the Ph. D. include: an M.A. degree or equivalent; completion of two required courses, PCOM 700 and either PCOM 701 or 702; minimum of 15 hours

of 600–800 level course work in journalism or in the three divisions of Communication Arts and Theatre; a minimum of nine hours in cognate graduate level courses elsewhere in the university; courses recommended by the doctoral committee to enhance research competence; successful completion of a written qualifying examination taken upon completion of the minimum course work; and submission and defense of a doctoral dissertation. Applicants must normally have an M. A. degree in one of the four areas of the program. They must also submit GRE scores, evidence of scholarly potential, and three letters of recommendation.

Additional courses for students in the Public Communication Program are listed under the Journalism and the Communication Arts and Theatre program entries.

Facilities and Special Resources

The University of Maryland is in an especially advantageous location for students wishing to pursue a degree in Public Communication. Several of the nation's major newspapers originate in the area, and the Washington bureaus of national and international news media are nearby. The University is also close to the John F. Kennedy Center for the Performing Arts, Arena Stage, and the National, Ford's and Folger Theatres, and the Wolf Trap Farm Park for the Performing Arts.

Of the many important libraries which are in close proximity to the Campus, two of the most outstanding are the Library of Congress and the Folger Shakespeare Library. Students also make use of the Broadcast Pioneers Library, the Smithsonian Institution, the National Archives and the more than 50 specialized libraries and institutions in the Washington metropolitan area.

Financial Assistance

Students may apply for research or teaching assistants in the College of Journalism or the Department of Communication Arts and Theatre. Likewise, a limited number of fellowships, scholarships, and internships are available to qualified students.

Additional Information

For information on the Ph.D. in Public Communication, contact Dr. Roger Meersman, Director, Ph.D. Program in Public Communication, Department of Communication Arts and Theatre.

Courses

PCOM 700 Introduction to Doctoral Study in the Public Communication Arts (3) The creation of an historical-critical context for reviewing the public communications arts. Significant questions underlying the disciplines of speech and communication, theatre, broadcasting and film

PCOM 701 Methodological Approaches to the Study of Public Communication Arts The significant modes of inquiry practiced by scholars investigating the public communications arts.

PCOM 899 Doctoral Dissertation Research (1–8)

Recreation Program

Professor and Chairman: Humphrey
Associate Professors: Churchill, Kuss, Strobell, Verhoven
Assistant Professors: Allen, Colton, Leedy,
Lecturer: Kelley, Munson

The Department of Recreation offers both the M.A. and Ph.D. degrees. Special areas of concentration include Administration, Therapeutic Recreation, Program Planning, Natural and Historical Interpretation, Resource Planning and Management, and others. The program of advanced studies is designed to assist professional practitioners in the leisure services field; and to prepare those who wish to enter the teaching profession, government or institutional service, and those who have interests in community services and education.

Admission and Degree Information

Students are required to present Graduate Record Examination scores and evidence of work experience in addition to fulfilling the regular admission requirements of the Graduate School. Doctoral students must complete either a language requirement or an approved substitute. A thesis or dissertation is required of all students.

Facilities and Special Resources

Recreation students have access to the University's McKeldin Library, the College's Research Laboratory and statistical resources, the Computer Science Center, the almost unlimited facilities and programs of the metropolitan areas of Baltimore and Washington, D.C., and to the headquarters and offices of appropriate national organizations, agencies and federal governmental units in the nation's Capital.

Financial Assistance

A limited number of teaching and research assistantships are available to qualified graduate students.

Additional Information

For additional information about specific requirements, please contact Dr. Karl Munson, Graduate Coordinator, Department of Recreation, University of Maryland.

Courses

RECR 410 Measurement and Evaluation in Recreation. (3) Prerequisite: RECR 130 or 325 or consent of instructor. A survey course in measurement tools and methods and application of measurement to evaluative processes applicable in specific and broad areas of interest and specialization in recreation and parks.

RECR 415 Quantitative Methods. (3) A course covering the statistical techniques most frequently used in research pertaining to recreation. An effort will be made to provide the student with the necessary skills, and to acquaint him with the interpretations and practical applications of these techniques.

RECR 420 Program Planning and Analysis. (3) Prerequisite: RECR 130 or 325; RECR 220 recommended. The essential elements and basic principles involved in the organization and administration of various types of recreation programs with emphasis on the development of practical, comprehensive program plans and evaluations for a population and facility within the student's particular area of interest.

RECR 426 Industrial Employee Recreation. (3) An introductory study of the philosophy of and practices and problems in Industrial Recreation. Where possible the course will include opportunities for observation and for meeting visiting specialists.

RECR 432 Philosophy of Recreation. (3) A study of the meanings, relationships, and services of recreation as expressed by past and present authorities and leaders. This course should be of interest to people active in education, social work, and related fields.

RECR 450 Camp Management. (3) Prerequisite: RECR 150 or experience. An advanced camping course for those students with previous training and experience; organization, administration, programming, current trends, evaluation, and special problems. Whenever possible, visiting specialists and field trips will be included.

RECR 451 Recreational Use of Natural Areas. (3) An introductory orientation to the outdoor recreation phenomenon. Factors stimulating outdoor recreation involvement; federal, state, local, public and private departments and agencies managing outdoor recreation areas; legislation; philosophical concepts; and planning and management issues.

RECR 454 Outdoor Education. (6) Field experience and resident camping in an outdoor setting will be used to present the activities and techniques recommended for modern outdoor education practice. Where possible groups of participants will be utilized as subjects for practice instructional work. Activity will emphasize not only the subject matter of science and education but also the broad concepts of conservation, worthy use of leisure time, education for democratic living, etc.

RECR 455 Historical and Natural Interpretation. (3) Prerequisite: RECR 351. Examination of the philosophies of and techniques appropriate to historical and natural interpretation. Analysis and development of interpretive programs and visitor information services. Field trips and laboratory experiences will be required.

RECR 457 Concepts and Issues in Outdoor Recreation. (3) A survey of the relationships between land, leisure and people as increasingly vital and interdependent issues in American civilization. The mainstream of thoughts, methods and policies of resource based recreation, with special attention to the history of conservation and the significance of wilderness.

RECR 460 Leadership Techniques and Practices. (3) Prerequisite: RECR 130 or 325. Various types and dynamics of recreation leadership at academic, agency, small and large group levels. Acquisition of tangible techniques, such as goal setting, decision making, and leadership for purposes of organizing, implementing, observing and analyzing human function in organizational settings.

RECR 463 Supervisory Techniques in Recreation. (3) A study of the principles, methods, techniques as well as an analysis of the functions of supervision in the recreation and parks environment. This course is designed to advance the student's understanding of the art of building human relationships, and to apply the emerging concepts and principles of modern supervision to practical situations in which administrators, supervisors, leaders (both professional and paraprofessional) and volunteers are working.

RECR 475 Problems in Therapeutic Recreation. (3) Prerequisite: RECR 375. Problems encountered in the delivery of therapeutic recreation services to individuals with special problems. Current trends, innovative service delivery models, literature review, and identification of funding sources.

RECR 476 Institutional Recreation. (3) An introductory study of the philosophy of and practices in hospital and Institutional Recreation. Where possible the course will include opportunities for observation and for meeting visiting specialists.

RECR 489 Field Laboratory Projects and Workshop. (1–6) A course designed to meet the needs of persons in the field with respect to workshops and research projects in special areas of knowledge not covered by regularly structured courses.

RECR 490 Organization and Administration of Recreation. (3) A study of the organizational patterns and administrative problems involved in the various types of operating recreation departments and agencies; forms of organization; finance and budget; personnel; public relations.

RECR 495 Recreation Resource and Facility Planning I. (3) Basic principles of planning, design, development, and maintenance of community recreation areas and facilities. The interrelationships between local, regional, state, and national park and recreation systems.

RECR 497 Recreation Resource and Facility Planning II. (3) Prerequisite: RECR 495 or consent of instructor. Principles of design, development, procedures, and maintenance considerations for recreation areas and facilities. Use of analytical methods to carry out park designs and development of skills in graphically conveying design concepts. Safety, efficiency and economy as they affect design, development and park maintenance.

RECR 498 Special Topics in Recreation. (3) Prerequisite: Consent to instructor. Topics of special inerest in areas not covered by regularly scheduled courses. Repeatable when the subject matter is different.

RECR 600 Seminar in Recreation. (1) Presentation, discussion and defense of student thesis proposals and outlines and/or of appropriate faculty projects and research activities.

RECR 610 Methods and Techniques of Research. (3) A study of appropriate research methodology including experimental, historical, philosophical, sociological and case study techniques, examples and problems. Each student is required to develop a specimen thesis or dissertation proposal and outline.

RECR 613 Source Material Survey. (3) Study and use of library resources and bibliographical materials of all types through their application to varieties or research problems and interests. Each student carries out special projects of his own initiation.

RECR 633 Foundations of Recreation. (3) A broad study of the sociological, psychological and economic forces that historically have structured attitudes toward leisure and the development of recreation.

RECR 634 Modern Trends in Recreation. (3) A broad study and overview of the recent advances in the several sub areas of recreation: public sector (local, state, federal and international government involvements); therapeutic (for special groups, such as ill, delinquent, aging, etc.); employee; voluntary agencies; religious organizations; family, school, camping areas; private and commerical sector. Each student will carry out special projects according to his interests.

RECR 687 Advanced Seminar. (1–3) Prerequisite: Consent of instructor. Advanced topics in the various areas of Recreation. May be taken for repeated credits, up to a total of 3.

RECR 688 Special Problems in Recreation. (1–6)

RECR 690 Administrative Direction of Recreation. (3) This course is concerned with analyzing various problems in the administration of leisure services in parks and other recreational settings. Students concentrate on simulated situations and their own on-the-job problems to enhance their understanding of sound administrative practice and to improve their problem-solving and decision-making abilities.

RECR 700 Advanced Doctoral Seminar. (1) Presentation, discussion and defense of doctoral dissertation proposals and outlines and/or of appropriate faculty projects and research activities.

RECR 799 Master's Thesis Research. (1–6)

RECR 899 Doctoral Dissertation Research. (1–8)

Secondary Education Program

Professor and Chairman: Risinger
Professors: Campbell, Carr, Folstrom[1], Lockard[3],
Associate Professors: Adkins, Anderson, Brigham, Cirrincione[4], Craig, Davey, Davidson[5], DeLorenzo, Farrell[6], Fey[5], Funaro, Hancock, Heikkinen[2], Henkelman[5], Layman[7], Longley, McWhinnie[8], Peters, Ridky[13], Ruchkin[14], Wheatley[15] Wright[15]
Assistant Professors: Brewster, Cooney, Craft[16], Ferran, Fitzgibbons[17], James[12], Lenz[1], McCaleb[11], Vaccaro[16]

[1] Joint appointment with Music
[2] Joint appointment with Chemistry
[3] Joint appointment with Botany
[4] Joint appointment with Geography
[5] Joint appointment with Mathematics
[6] Joint appointment with History
[7] Joint appointment with Physics
[8] Joint appointment with Housing and Applied Design
[9] Joint appointment with Spanish and Portuguese
[10] Joint appointment with Speech and Dramatic Art
[11] Joint appointment with English
[12] Joint appointment with Geology
[13] Joint appointment with Office of Laboratory Experiences
[14] Joint appointment with Agriculture
[15] Joint appointment with Physical Education
[16] Joint appointment with Library and Information Services

The Department offers programs leading to the degrees of Master of Arts (thesis and non-thesis), Master of Education, the Advanced Graduate Specialist, Doctor of Education, and Doctor of Philosophy. The Department offers a variety of programs, individually designed to meet the personal and professional goals of graduate students. These goals may include teaching at secondary and college levels, supervision and improvement of instruction within the disciplines, teacher education, and research in any of these.

Areas of emphasis include education in art, business education, distributive education, English and language arts, foreign languages, home economics, journalism, mathematics, music, reading, science, social studies, speech, TESOL and interdisciplinary studies.

Admission and Degree Information

The master's degree programs require 30 to 36 semester hours, the AGS program 60 hours beyond the bachelor's degree, and the doctorate a planned sequence of approximately 60 semester hours (or the equivalent) beyond the master's degree. There are no foreign language requirements unless the dissertation is on a topic that requires it.

Admission to doctoral programs requires a master's degree or its equivalent, an acceptable Miller's Analogies score, a good scholastic record, and recommendations for advanced study. A preliminary examination, usually written, is given at the end of 20 semester hours of doctoral work, to determine the student's aptitude for advanced graduate study. A comprehensive examination, also usually written, is given at the conclusion of course work. An oral examination in defense of the thesis constitutes the final step in completing the doctorate.

Financial Assistance

A limited number of graduate assistantship for selected students are available in the Department of Secondary Education. These assistants generally provide help in the supervision of student teachers, in teaching undergraduate classes, or by aiding in other ways.

Additional Information

Write or call the Department (301—454-2021, 2022 or 2023) for more specific information about the various programs.

Courses

EDSE 402 Methods and Materials in Teaching Bookkeeping and Related Subjects. (3) Important problems and procedures in the mastery of bookkeeping and related office knowledge and the skills including a consideration of materials and teaching procedures.

EDSE 403 Problems in Teaching Office Skills. (3) Problems in development of occupational competency, achievement tests, standards of achievement, instructional materials, transcription, and the integration of office skills.

EDSE 404 Basic Business Education in the Secondary School. (3) Includes consideration of course objectives; subject matter selection; and methods of organization and presenting business principles, knowledge and practices.

EDSE 415 Financial and Economic Education I. (3) Problems of teaching courses in personal finance and economics in the public schools, including materials and resources.

EDSE 416 Financial and Economic Education II. (3) Continuation of EDSE 415.

EDSE 420 Organization and Coordination of Distributive Education Programs. (3) This course deals specifically with such areas as the organization of a cooperative distributive education program; the development of an effective cooperative relationship between coordinator and training sponsor: the selection, orientation, and training of sponsors; analysis of training opportunities, reports and records, the evaluation and selection of students for part-time cooperative work assignments; and the evaluation of the program.

EDSE 421 Methods and Materials in Distributive Education. (3) This course covers basic methods and materials needed to teach the preparatory classroom related instruction of a one or two year distributive education program. It deals specifically with the organization of special supplementary materials for individual and group instruction youth club programs, organization and administration.

EDSE 423 Field Experiences in Vocational Areas. (3) A—Home Economics Education, B—Business Education, C—Distributive Education, Supervised work experience in an occupation related to Vocational Education. Application of theory to work situations as a basis for teaching in Vocational Education programs. By individual arrangement with advisor.

EDSE 425 Curriculum Development in Home Economics. (3) An analysis of curriculum development including the tools for planning, managing, and evaluating the teaching/learning environment of conceptual curriculum design. Includes a field experience.

EDSE 430 Corrective-Remedial Reading Instruction. (3) Prerequisite: EDEL/EDSE 427 or equivalent, and consent of the department. For teachers, supervisors, and administrators who wish to identify and assist pupils with reading difficulties. Concerned with diagnostic techniques, instructional materials and teaching procedures useful in the regular classroom.

EDSE 431 Laboratory Practices in Reading. (2–4) Prerequisite: EDSE 430. A laboratory course in which each student has one or more pupils for analysis and instruction. At least one class meeting per week to diagnose individual cases and to plan instruction.

EDSE 432 The Junior High School. (2–3) A general overview of the junior high school. Purposes, functions and characteristics of this school unit; a study of its population, organization, program of studies, methods, staff, and other topics, together with their implications for prospective teachers.

EDSE 440 Methods of Teaching English in Secondary Schools. (3)

EDSE 441 Practicum in Art Education. (3) One two-hour lecture discussion period and two, two-hour laboratory sessions per week. Instruction will be aimed at reviewing experiences in a chosen medium of art and assembling a workable procedure to present the content to secondary school students. The course will provide a studio setting in which the student will assemble materials for an in-depth study of the practical work involved and attempt to develop a total concept in a particular area of art.

EDSE 442 Teaching the Audio-Lingual Skills in Foreign Languages. (3)

EDSE 444 Methods of Teaching Mathematics in Secondary Schools. (3)

EDSE 446 Methods of Teaching Science in Secondary Schools. (3)

EDSE 447 Methods of Teaching Social Studies in Secondary Schools. (2–3)

EDSE 450 Speech Methods and Resources in Secondary Schools. (3)

EDSE 453 The Teaching of Reading in the Secondary School. (3)

EDSE 460 Environmental Education. (3) Two lecture-discussion periods and one three hour laboratory-field experience session per week. An interdisciplinary course covering the literature, techniques and strategies of Environmental Education. Emphasis is upon the study of Environmental Education programs and the development of a specific program which is designed to implement the solution of an environmental problem. The laboratory-field experience is provided as a model for future activities of students. Open to any student who wishes to become actively involved in the process of Environmental Education program development.

EDSE 461 Methods of Teaching English to Speakers of Other Languages. (3) An introductory course in methods for teaching listening, speaking, reading and writing techniques and a review of research findings.

EDSE 470 Teaching of Art Criticism in Public Schools. (3) Introduction to various alternative theories of aesthetics as related to the teaching of art.

EDSE 488 Special Topics in Secondary Education. (1–3) Repeatable for a maximum of 6 hours.

EDSE 489 Field Experience in Education. (1–4) Prerequisite: At least six semester hours in Education at the University of Maryland plus such other prerequisites as may be set by the Secondary Education Department. Planned field experience may be provided for selected students who have had teaching experience and whose application for such field experience has been approved by the Secondary Education faculty. Field experience is offered in a given area to both major and non-major students. Note: The total number of credits which a student may earn in EDSE 489, 888, and 889 is limited to a maximum of 20 semester hours.

EDSE 498 Special Problems in Education. (1–3) Prerequisite: Consent of instructor. Available only to mature students who have definite plans for individual study of approved problems.

EDSE 499 Workshops, Clinics, and Institutes. (1–6) The maximum number of credits that may be earned under this course symbol toward any degree is six semester hours; the symbol may be used two or more times until six semester hours have been reached The following type of educational enterprise may be scheduled under this course heading: workshops conducted by the College of Education (or developed cooperatively with other colleges and universities) and not otherwise covered in the present course listing; clinical experiences in pupil-testing centers, reading clinics, speech therapy laboratories, and Special Education centers; institutes developed around specific topics or problems and intended for designated groups such as school superintendents, principals and supervisors.

EDSE 600 Administration and Supervision of Business Education. (3) Major emphasis on departmental organization and its role in the school program, curriculum, equipment, budget-making, supervision, guidance, placement and follow-up, school-community relationships, qualifications and selection of teaching staff, visual aids, and in-service programs for teacher development. For administrators, supervisors, and teachers.

EDSE 605 Principles and Problems of Business Education. (2–3) Principles, objectives, and practices in Business Education; occupational foundations; current attitudes of business, labor and school leaders; General Business Education relation to Consumer Business Education and to education in general.

EDSE 606 Curriculum Development in Business Education. (2–3) This course is especially designed for graduate students interested in a concentrated study of curriculum planning in Business Education. Emphasis will be placed on the philosophy and objectives of the Business Education program, and on curriculum research and organization of appropriate course content.

EDSE 624 Reading Diagnostic Assessment and Prescription. (3) Prerequisites: 12 credits of graduate study in Education, or consent of instructor. Survey course in reading diagnosis and prescription. For graduate students not majoring in Reading. The interpretation of reading with diagnostic techniques with an overview of various prescriptions based on diagnosis.

EDSE 625 Introduction to Field Methods in School and Community. (3) Prerequisite: Permission of instructor. Applies selected field methods to problems of professional practice. Issues pertaining to the role and responsibilities of the field investigator, working in schools and other service agencies. Students will design one or more field studies utilizing qualitative field techniques.

EDSE 626 Problems in Teaching Reading in Secondary Schools. (3) Problems in the Teaching of Reading in the secondary school. Implications of current theory and the results of research for the Teaching of Reading in the secondary school. Attention is given to all areas of development reading instruction, with special emphasis on persistent problems.

EDSE 627 Clinical Assessment in Reading. (3) Prerequisites: EDEL 430, EDEL 626, EDMS 446 and EDMS 622. Clinical diagnostic techniques and materials useful to the reading specialist in assessing serious reading difficulties.

EDSE 630 Clinical Remediation of Reading Disabilities. (3) Prerequisites: EDEL 430, EDEL 626, EDMS 446 and 622. Remedial procedures and materials useful to the reading specialist in planning programs of individual and small group instruction.

EDSE 631 Advanced Laboratory Practices (Diagnosis). (3) Prerequisite: EDSE 630. Diagnostic work with children in clinic and school situations. Administration, scoring, interpretation, and prescription via diagnostic instruments is stressed. Case report writing and conferences are also stressed. EDSE 631 is taken with EDSE 632.

EDSE 632 Advanced Laboratory Practices (Instruction). (3) Prerequisite: EDSE 630. Remedial instruction with children in clinic and school situations. Develop competency in various remedial techniques, diagnostic teaching and evaluation. Development of the reading resource role is stressed. EDSE 632 is taken with EDSE 631.

EDSE 636 Evaluation of Home Economics (3) Prerequisites: EDSE 425, EDMS 645. Evaluation devices, construction and use in home economics programs.

EDSE 637 Seminar in Secondary Education. (3)

EDSE 640 Trends in Secondary School Curriculum—General. (3) Recent developments in educational thinking and practice which have affected the curriculum.

EDSE 641 Trends in Secondary School Curriculum—Art. (3) Recent developments in educational thinking and practice which have affected the curriculum in Art Education.

EDSE 642 Trends in Secondary School Curriculum—Business. (3) Recent developments in educational thinking and practice which have affected the curriculum in Business Education.

EDSE 643 Trends in Secondary School Curriculum—Distributive Education. (3) Recent developments in educational thinking and practice which have affected the curriculum in Distributive Education.

EDSE 644 Trends in Secondary School Curriculum—English. (3) Recent developments in educational thinking and practice which have affected the curriculum in English Education.

EDSE 645 Trends in Secondary School Curriculum—Foreign Language. (3) Recent developments in educational thinking and practice which have affected the curriculum in Foreign Language Education.

EDSE 646 Trends in Secondary School Curriculum—Geography. (3) Recent developments in educational thinking and practice which have affected the curriculum in Geography.

EDSE 647 Trends in Secondary School Curriculum—Mathematics. (3) Recent developments in educational thinking and practice which have affected the curriculum in Mathematics.

EDSE 650 Trends in Secondary School Curriculum—Science. (3) Recent developments in educational thinking and practice which have affected the curriculum in Science Education.

EDSE 651 Trends in Secondary School Curriculum—Social Studies. (3) Recent developments in educational thinking and practice which have affected the curriculum in Social Studies.

EDSE 652 Trends in Secondary School Curriculum—Speech. (3) Recent developments in educational thinking and practice which have affected the curriculum in Speech.

EDSE 653 Trends in Secondary School Curriculum—Urban Schools. (3) Recent developments in educational thinking and practice which have affected the curriculum in Urban Schools.

EDSE 654 Trends in Secondary School Curriculum—Reading. (3) Prerequisites: EDSE 453, EDMS 446. Recent developments in educational thinking and practice which have affected the curriculum in Reading.

EDSE 700 History of Art Education. (3) A study of the growth of the art curriculum in American schools. Perspective on Art Education philosophy as viewed through a historical survey beginning with the United States Colonial Period to the present.

EDSE 701 The Teaching of Art Criticism. (3) The aesthetic foundations of Art Education. Development of skills necessary for critical investigation of works of art, and identification of curriculum implications resulting from various aesthetic and psychological approaches to art.

EDSE 705 Trends in the Teaching and Supervision of Home Economics. (3) Study of Home Economics programs and practices in light of current educational trends. Interpretation and analysis of democratic teaching procedures, outcomes of instruction, and supervisory practices.

EDSE 740 Theory and Research in Secondary Education—General. (1–3) A survey of the research literature; evaluation of research techniques; consideration of relevant instructional curriculum theory; evaluation of modern teaching methods and techniques.

EDSE 741 Theory and Research in Secondary Education—Art. (1–3) A survey of the research literature; evaluation of research techniques; consideration of relevant instructional curriculum theory; evaluation of modern teaching methods and techniques.

EDSE 742 Theory and Research in Secondary Educationn—Business. (1–3) A survey of the research literature; evaluation of research techniques; consideration of relevant instructional curriculum theory; evaluation of modern teaching methods and techniques.

EDSE 743 Theory and Research in Secondary Education—Distributive. (1–3) A survey of the research literature; evaluation of research techniques; consideration of relevant instructional curriculum theory; evaluation of modern teaching methods and techniques.

EDSE 744 Theory and Research in Secondary Education—English. (1–3) A survey of the research literature; evaluation of research techniques; consideration of relevant instructional curriculum theory; evaluation of modern teaching methods and techniques.

EDSE 745 Theory and Research in Secondary Education—Foreign Language. (1–3) A survey of the research literature; evaluation of research techniques; consideration of relevant instructional curriculum theory; evaluation of modern teaching methods and techniques.

EDSE 746 Theory and Research in Secondary Education—Home Economics. (1–3) A survey of the research literature; evaluation of research techniques; consideration of relevant instructional curriculum theory; evaluation of modern teaching methods and techniques.

EDSE 747 Theory and Research in Secondary Education—Mathematics. (1–3) A survey of the research literature; evaluation of research techniques; consideration of relevant instructional curriculum theory; evaluation of modern teaching methods and techniques.

EDSE 750 Theory and Research in Secondary Education—Music. (1–3) A survey of the research literature; evaluation of research techniques; consideration of relevant instructional curriculum theory; evaluation of modern teaching methods and techniques.

EDSE 751 Theory and Research in Secondary Education—Reading. (1–3) A survey of the research literature; evaluation of research techniques; consideration of relevant instructional curriculum theory; evaluation of modern teaching methods and techniques.

EDSE 752 Theory and Research in Secondary Education—Science. (1–3) A survey of the research literature; evaluation of research techniques; consideration of relevant instructional curriculum theory; evaluation of modern teaching methods and techniques.

EDSE 753 Theory and Research in Secondary Education—Social Studies. (1–3) A survey of the research literature; evaluation of research techniques; consideration of relevant instructional curriculum theory; evaluation of modern teaching methods and techniques.

EDSE 754 Theory and Research in Secondary Education—Speech. (1–3) A survey of the research literature; evaluation of research techniques; consideration of relevant instructional curriculum theory; evaluation of modern teaching methods and techniques.

EDSE 755 Theory and Research in Secondary Education—Urban Education. (1–3) A survey of the research literature; evaluation of research techniques; consideration of relevant instructional curriculum theory; evaluation of modern teaching methods and techniques.

EDSE 788 Special Topics in Secondary Education. (1–3) Prerequisite: EDSE 640 appropriate to area of concentration, or consent of instructor. Repeatable to a maximum of 6 hours.

EDSE 798 Special Problems in Education. (1–6) Master's, AGS, or doctoral candidates who desire to pursue special reserach problems under the direction of their advisors may register for credit under this number.

EDSE 799 Master's Thesis Research. (1–6) Registration required to the extent of six hours for master's thesis.

EDSE 820 Seminar in Art Education. (3)

EDSE 821 Seminar in Business Education. (3)

EDSE 822 Seminar in Computer Assisted Instruction. (3)

EDSE 823 Seminar in Distributive Education. (3)

EDSE 824 Seminar in English Education. (3)

EDSE 825 Seminar in Foreign Language Education. (3)

EDSE 826 Seminar in Home Economic Education. (3)

EDSE 827 Seminar in Mathematics Education. (3)

EDSE 830 Seminar in Reading Education. (3) Prerequisite: EDSE 751. Exploration of major issues of theory, research and program development of concern to those in positions of advanced professional leadership. Interinstitutional and interdisciplinary factors will be considered.

EDSE 831 Seminar in Science Education. (3)

EDSE 832 Seminar in Social Studies Education. (3)

EDSE 833 Seminar in Speech Education. (3)

EDSE 834 Seminar in Urban Education. (3)

EDSE 835 Seminar in Behavioral Objectives. (3)

EDSE 888 Apprenticeship in Education. (1–8) Apprenticeships in the major area of study are available to selected students whose application for an apprenticeship has been approved by the Education faculty. Each apprentice is assigned to work for at least a semester full-time or the equivalent with an appropriate staff member of a cooperating school, school system, or educational institution or agency. The sponsor of the apprentice maintains a close working relationship with the apprentice and the other persons involved. Prerequisites: Teaching experience, a Master's degree in Education, and at least six semester hours in Education at the University of Maryland. Note: The total number of credits which a student may earn in EDSE 489, 888, and 889 is limited to a maximum of twenty (20) semester hours.

EDSE 889 Internship in Education. (3–8) Internships in the major area of study are available to selected students who have teaching experience. The following groups of students are eligible: (a) Any student who has been advanced to candidacy for the doctor's degree; and (b) Any student who receives special approval by the Education faculty for an internship, provided that prior to taking an internship, such student shall have completed at least 60 semester hours of graduate work, including at least six semester hours in Education at the University of Maryland. Each intern is assigned to work on a full-time basis for at least a semester with an appropriate staff member in a cooperating school, school system, or educational institution or agency. The internship must be taken in a school situation different from the one where the student is regularly employed. The intern's sponsor maintains a close working relationship with the intern and the other persons involved. Note: The total number of credits which a student may earn in EDSE 489, 888, and 889 is limited to a maximum of twenty (20) semester hours.

EDSE 899 Doctoral Dissertation Research. (1–8) Registration required to the extent of 6–9 hours for an Ed.D. project and 12–18 hours for a Ph.D. dissertation.

Social Foundations of Education Program

Associate Professor and Coordinator: Finkelstein
Professor: Male
Associate Professors: Agre, Hopkins, Huden, Lindsay, Noll

The objectives of the doctoral program in Foundations of Education are to prepare specialists in the disciplines of history of education, philosophy of education, educational sociology and comparative education and some generalists with a broad command of two or more of these fields. The specialists and generalists are prepared for undergraduate and graduate college or university teaching, for research, and for policy positions. Foundations courses are also used to enrich programs in other areas and to provide needed disciplinary capacity for students whose research and career goals require it.

Admission and Degree Information

Graduate Foundations majors, and particularly those at the doctoral level, are expected to have knowledge of the history, sociology, and philosophy of education as well as comparative education. Each in turn specializes in one of these areas with opportunities for related course work in either history, philosophy, government and politics, anthropology, or sociology. Programs are tailored to a student's objectives and background.

The master's program offers a non-thesis option (30 hours) and a thesis option (24 hours). Graduates of the master's program find positions in research or policy units in public school systems or in educational organizations, in community agencies, or in social action programs with an eduational component. Some take positions with international organizations dealing with education or teach in schools located in other countries.

In addition to the overall B average a Master of Arts applicant must have a B average in the last two years of the undergraduate program from a regionally accredited institution. An applicant for the Doctor of Philosophy degree must have strong undergraduate and graduate records and a Miller Analogies Test score at the midpoint or better of the graduate education population at the University of Maryland.

The requirements for the M.A. with and without thesis, and for the Ph.D. conform to those of the Graduate School. Students in the doctoral program take a preliminary examination (6 hours in length) after they have completed between 12 and 18 hours of course work.

Facilities and Special Resources

The College Park campus is adjacent to embassies which provide access to materials for the study of foreign education systems. The Library of Congress, Office of Education and Archives are valuable and accessible. Staff members in Foundations are assigned to a Comparative Education Center which provides research facilities to students from both foreign and American backgrounds.

Courses

EDSF 409 Special Topics in the Social Foundations of Education. (1–3) Repeatable to a maximum of nine hours. An intensive examination of current problems and issues in the formation of educational policies. May be repeated for credit when the topics dealt with are different.

EDSF 410 History of Education in Western Civilization. (3) Educational institutions through the ancient, medieval and early modern periods in Western Civilization, as seen against a background of socio-economic development.

EDSF 411 History of Education in the United States. (3) A study of the origins and development of the chief features of the present system of education in the United States.

EDSF 420 Philosophy of Education. (3) A study of the great educational philosophers and systems of thought affecting the development of modern education.

EDSF 421 Logic of Teaching. (3) An analysis of the structure of basic subject matters in the curriculum and of the standard logical moves in teaching.

EDSF 430 Educational Sociology. (3) Deals with data of the Social Sciences which are germane to the work of teachers. Implications of democratic ideology for educational endeavor, educational tasks imposed by changes in population and technological trends, the welfare status of pupils, the socioeconomic attitudes of individuals who control the schools, and other elements of community background.

EDSF 489 Field Experience in Education. (1–4) Prerequisites: At least six semester hours in Education at the University of Maryland plus such other prerequisites as may be set by the major area in which the experience is to be taken. Planned field experience may be provided for selected students who have had teaching experience and whose application for such field experience has been approved by the Education faculty. Field experience is offered in a given area to both major and nonmajor students. Note: The total number of credits which a student may earn in EDSF 489, 888, and 889 is limited to a maximum of 20 semester hours.

EDSF 498 Special Problems in Education. 1–3) Prerequisite: Consent of instructor. Available only to mature students who have definite plans for individual study of approved problems.

EDSF 499 Workshops, Clinics, and Institutes. (1–6) The maximum number of credits that may be earned under this course symbol toward any degree is six semester hours; the symbol may be used two or more times until six semester hours have been reached The following type of educational enterprise may be scheduled under this course heading: workshops conducted by the College of Education (or developed cooperatively with other colleges and universities) and not otherwise covered in the present course listing; clinical experiences in pupil-testing centers, reading clinics, speech therapy laboratories, and Special Education centers; institutes developed around specific topics or problems and intended for designated groups such as school superintendents, principals and supervisors.

EDSF 601 Contemporary Social Issues in Education. (3) Theoretical and practical consideration of vital social issues currently affecting education.

EDSF 620 Analysis of Educational Concepts. (3)

EDSF 660 Comparative Education. (3) Analyzes and compares leading issues in education in various countries of the world, particularly as they relate to crucial problems in American education.

EDSF 661 International Educational Change. (3) An exploration and analysis of major trends in education in several parts of the world, with attention directed to educational change as the outcome of deliberate efforts by nations and international organizations as well as those which occur without central planning or direction.

EDSF 670 Education in Africa. (3) An examination of the development of modern educational systems in Africa south of the Sahara out of the colonial and precolonial past into the independent present and future. The focus is on research into the changing philosophies and persistent problems in African education.

EDSF 671 Education in the Near East. (3) A consideration of current educational problems of the Near East as they have emerged from the confrontation of the traditional Muslim educational heritage with the foreign educational activities and the forces of nationalism and modernization.

EDSF 709 Advanced Research Methods. (3) Specific methodologies employed in educational studies based upon social foundations disciplines.

EDSF 710 Seminar in History of Education. (3) Examination of current developments and continuing controversies in the field of history of Education. The analysis of the various ways in which history of Education is approached methodologically and interpretatively.

EDSF 720 Seminar in Philosophy of Education. (3) Examination of current developments and continuing controversies in the field of philosophy of Education. The function of educational philosophy, methodological approaches, and current research trends.

EDSF 730 Seminar in Educational Sociology. (3)

EDSF 760 Seminar in Comparative Education. (3)

EDSF 798 Special Problems in Education. (1–6) Master's AGS, or doctoral candidates who desire to pursue special research problems under the direction of their advisers may register for credit undet this number.

EDSF 799 Master's Thesis Research. (1–6) Registration required to the extent of 6-hours for master's thesis.

EDSF 888 Apprenticeship in Education. (1–8) Apprenticeships in the major area of study are available to selected students whose application for an apprenticeship has been approved by the Education faculty. Each apprentice is assigned to work for at least a semester full-time or the equivalent with an appropriate staff member of a cooperating school, school system, or educational institution or agency. The sponsor of the apprentice maintains a close working relationship with the apprentice and the other persons involved. Prerequisites: Teaching expenence, a Master's degree in Education, and at least six semester hours in Education at the University of Maryland. Note: The total number of credits which a student may earn in EDSF 489, 888 and 889 is limited to a maximum of twenty (20) semester hours.

EDSF 889 Internship in Education. (3–8) Internships in the major area of study are available to selected students who have teaching experience. The following groups of students are eligible: (a) Any student who has been advanced to candidacy for the doctor's degree; and (b) Any student who receives special approval by the Education faculty for an internship, provided that prior to taking an internship, such student shall have completed at least 60 semester hours of graduate work, including at least six semester hours in Education at the University of Maryland. Each intern is assigned to work on a full-time basis for at least a semester with an appropriate staff member in a cooperating school, school system, or educational institution or agency. The internship must be taken in a school situation different from the one where the student is regularly employed. The intern's sponsor maintains a close working relationship with the intern and the other persons involved. Note: The total number of credits which a student may earn in EDSF 489, 888, and 889 is limited to a maximum of twenty (20) semester hours.

EDSF 899 Doctoral Dissertation Research. (1–8) Registration required to the extent of 6–9 hours for an Ed.D. project and 12–18 hours for a Ph.D. dissertation.

Sociology Program

Professor and Chairman: Hage
Professors: Dager, Janes, Kammeyer, Lejins (Emeritus), Presser, Ritzer, Rosenberg, D. Segal, Silbergold (Visiting)
Associate Professors: Brown, Cussler, Finsterbusch, Henkel, Hirzel, J. Hunt, L. Hunt, Lengermann, McIntyre, Meeker, Pease
Assistant Professors: Blair, Elliott, Harper, Landry, Mayes, Parming, M. Segal

The graduate program in Sociology offers course work leading to M.A. and Ph.D. degrees. Particular areas of emphasis in the Department include social psychology (socialization and personality, small groups, collective behavior and social movements, self-concept); quantitative methodology (data analysis, research design, mathematical sociology); applied sociological research; theory (history and development of theory, contemporary and critical theory); sex roles; sociology of work (formal organizations, occupations and professions); urban sociology; demography; sociology of the military. Other areas of specialization may be developed by individual students working with one or more of the faculty.

Admission and Degree Information

Admission to the graduate program is based upon the student's prior academic record, GRE scores, letters of recommendation, and other information relevant to the applicant's chances of successfully completing the program. Although a previous major in sociology is not required, students entering the Master's degree program should have had the following undergraduate courses; mathematics through college algebra, elementary statistics, sociological theory, and sociological research methods. Students entering the Ph.D. program should have had at least one graduate level course each in sociological theory, sociological research methods, and statistics. Students deficient in any of these areas may be admitted to the program provisionally, but must satisfy the requirements their first year in the program.

A minimum of 30 hours is required for the Master's degree, including one course each in statistics, sociological theory, and sociological research methods. A Master's thesis is required. Usually, this phase of the program can be completed in two years.

Ph.D. candidates should have met all the Master's degree requirements. In addition, there are four required courses, two of which may be taken at the Master's level (one each in sociological theory and sociological research methods) and two taken after beginning Ph.D. work (theory construction and issues in quantitative methods). Students should plan on a minimum of eighteen hours of course work, including at least one general examination in social organization and/or social psychology and at least one area of specialization. The language requirement may be met by passing a language exam or making a B or better in one of a number of other tool courses. Usually these requirements plus the dissertation can be completed in two or three years.

Facilities and Special Resources

The Sociology Department has just moved into a new building with ample office space and research space. Facilities include data processing and computer capabilities, a small groups laboratory, a demography laboratory, and a department library. The university has excellent computer facilities, and computer time is readily available to faculty and graduate students.

Financial Assistance

Financial assistance for graduate students is available through teaching and research assistantships, and for advanced students through part-time instructorships. All carry remission of tuition and fees.

Additional Information

For information and application forms, write or call:

Director of Graduate Studies
Sociology Department
Phone 301/454–5933

Courses

SOCY 401 Intermediate Statistics for Sociologists. (3) Prerequisite: SOCY 201 or equivalent, and six additional credits in Sociology. Intermediate correlation techniques, analysis of variance, sampling, additional nonparametric techniques, additional topics in Inferential Statistics.

SOCY 402 Intermediate Procedures for Data Collection (3) Prerequisite: SOCY 202 or equivalent or permission of the instructor. An intermediate survey of the major research methods used by sociologists, including survey research, experimentation, observation, archival research, and in-depth interviewing. The selection of an appropriate research method, with analysis of the strengths and weaknesses of various methods, practical issues, data collection and preparation, and analytical techniques.

SOCY 403 Intermediate Sociological Theory. (3) Prerequisite: SOCY 203 Major theoretical approaches e.g., functionalism conflict, symbolic interactionism, and their implicit methods of logic illustrated by case studies. Original works of major theorists in historical perspective.

SOCY 404 Methods of Quantitative Analysis (3) Prerequisite: SOCY 202 or equivalent or permission of instructor. A computer-based approach to the analysis of sociological data. Statistical program packages such as SPSS, using both card input and computer terminals; data storage and file manipulation. Use of multivanate statistical techniques, national sample surveys, census, and artificial data sets constructed to illustrate specific features of the techniques.

SOCY 410 Population I. (3) Prerequisite: Junior standing; SOCY 100 or 105 not required. Population distribution and growth; sources of demographic data; population composition; population theories; mortality; fertility and family planning; migration; and population problems and policy.

SOCY 411 Population II. (3) Prerequisite: SOCY 410 or permission of instructor. Introduction to basic techniques for analyzing population change. The measurement of fertility, mortality, and migration.

SOCY 423 Ethnic Minorities. (3) Prerequisite: SOCY 100 or 105. Basic social processes in the relations of ethnic groups; immigration groups and the Negro in the United States; ethnic minorities in Europe.

SOCY 424 Sociology of Race Relations. (3) Prerequisite: 9 credits in Sociology or permission of intructor. Analysis of race-related issues, with a primary focus on American society. The historical emergence, development, and institutionalization of racism; the impact of racism on its victims; and racially based conflict.

SOCY 425 Sex Roles and Social Institutions. (3) Prerequisite: 12 credits in Sociology. Relationship between sex roles and the structure of one or more social institutions (e.g., the economy, the family, the political system, religion, education). the issues of major concern are: how assumptions about sex roles are built into social institutions; how social institutions serve to perpetuate or transform sex roles; how changing sex roles affect social institutions.

SOCY 426 Sociology of Religion. (3) Prerequisite: SOCY 100 or 105. Varieties and sources of religious experience. Religious institutions and the role of religion in social life.

SOCY 427 Deviant Behavior. (3) Prerequisite: SOCY 327 or 12 credits in Sociology or permission of instructor. Current theories of the genesis and distribution of deviant behavior, and their implications for a general theory of deviant behavior. Definitions of deviance, labeling theory, secondary deviance.

SOCY 430 Sociology of Personality. (3) Prerequisite: SOCY 100 or 105. Development of human nature and personality in contemporary social life; processes of socialization; attitudes, individual differences and social behavior.

SOCY 431 Formal and Complex Organizations. (3) Prerequisite: SOCY 100 or 105. The concept of formal organization. The study of functioning and control in the operation of bureaucracies such as corporations and in large-scale organizations such as military, religious and educational hierarchies. Forms of recruitment, internal mobility and organizational personality. Relations between large-scale organizations and with the larger society.

SOCY 432 Collective Behavior. (3) Prerequisite: SOCY 100 or 105 or 230 or permission of instructor. Unlike most Sociology courses which focus on structured groups, this course examines instances of transient behavior: crowds, disasters, hysterical contagion, revolution, and social movements, including American utopian experiments.

SOCY 433 Social Control. (3) Prerequisite: SOCY 100 or 105 or 200. Forms, mechanism, and techniques of group influence on human behavior; problems of social control in contemporary society.

SOCY 441 Social Stratification. (3) Prerequisite: 9 credits of Sociology. An introduction to the Sociology of social stratification. Consideration of the basic concepts and major findings in the field. The relationship of social stratification to the institutional orders of the society.

SOCY 443 The Family and Society. (3) Prerequisite: SOCY 100 or 105. Study of the family as a social institution; its biological and cultural foundation; historic development, changing structure, and function; the interaction of marriage and parenthood, disorganizing and reorganizing factors in present day trends.

SOCY 445 Sociology of the Arts. (3) Prerequisite: SOCY 100 or 105. Functions of the arts as a social institution. Social role of the artist. Recruitment to and organizational structure of artistic professions. Art forms and social characteristics of audiences. Changing technology and social values as reflected in artistic expression.

SOCY 447 Small Group Analysis. (3) Prerequisites: SOCY 100 or 105 and 201 (sociological statistics) or equivalent. Analysis of small group structures and dynamics. Review of research on small groups in real life settings and in laboratories. Presentation of techniques used in small groups.

SOCY 457 Sociology of Law. (3) Prerequisite: SOCY 100 or 105. Law as a form of social control interrelation between legal and other conduct norms as to their content, sanctions, and methods of securing conformity; law as an integral part of the culture of groups; factors and processes operative in the formation of legal norms as determinants of human behavior.

SOCY 460 Sociology of Work. (3) Prerequisite: SOCY 100 or 105. Analysis of the American work world with special attention to the impact of social change and occupational conflicts on the individual worker. Professionalization, career patterns, problems of minority groups, and the future of work.

SOCY 462 Industrial Sociology. (3) Prerequisite: SOCY 100 or 105. The sociology of human relations in American industry and business. Complex industrial and business organization as social systems. Social relationships within and between industry, business, community, and society.

SOCY 464 Military Sociology. (3) Prerequisite: SOCY 100 or 105. Social change and the growth of military institutions. Complex formal military organizations. Military service as an occupation or profession. The sociology of military life. Relations between military institutions, civilian communities and society.

SOCY 465 The Sociology of War. (3) Prerequisite: SOCY 100 or 105. The origin and development of armed forces as institutions, the social causes, operations and results of war as social conflict; the relations of peace and war and revolution in contemporary civilizations.

SOCY 466 Sociology of Politics. (3) Prerequisite: 9 credits in Sociology. An introduction to the sociology of political phenomena. Consideration of the basis concepts and major findings in the field; the relationship of the polity to other institutional orders of the society; the relationship of political activity in America to the theory of democracy.

SOCY 467 Sociology of Education. (3) Prerequisites: SOCY 100 or 105 or permission of the instructor. Listed also as EDSF 430. Sociological analysis of educational institutions and their relation to society: goals and functions, the mechanisms of social control, and the impacts of stratification and social change. Study of the school as a formal organization, and the roles and subcultures of teachers and students.

SOCY 470 Rural-Urban Relations. (3) Prerequisite: SOCY 100 or 105. The ecology of population and the forces making for change in rural and urban life; migration, decentralization and regionalism as methods of studying individual and national issues. Applied field problems.

SOCY 473 The City. (3) Prerequisite: SOCY 100 or 105. The rise of urban civilization and metropolitan regions; ecological process and structure; the city as a center of dominance; social problems, control and planning.

SOCY 498 Selected Topics in Sociology. (1–3) Prerequisite: SOCY 100 or 105. Topics of special interest to advanced undergraduates in Sociology. Such courses will be offered in response to student request and faculty interest. No more than 6 credits may be taken by a student in selected topics.

SOCY 600 Logic of Social Inquiry. (3) Analysis through theoretical viewpoints of the process of social inquiry. Communalities and differences in theory in all the social sciences. The role of theory in the definition of research problems and in the interpretation of findings. The relation between epistemology, theory, and research techniques. Problems created by alternative paradigms in respect to these topic and issues.

SOCY 601 Multivariate Statistics. (3) Prerequisite: SOCY 401 or equivalent. Advanced treatment of inferential statistics; sampling; research design; nonparametric techniques; scaling.

SOCY 602 Intermediate Procedures of Data Analysis. (3) Prerequisites: Undergraduate training in sociological research methods, statistics, and theory of equivalent. This course is designed to provide the graduate student with practical experience in analyzing data. Extensive use of 'canned' computer programs is made to analyze available data. Knowledge of computer systems, languages, or applications is not a prerequisite. However, the student is required to have completed an introductory course in research methods and have a basic grasp of multivariate statistics.

SOCY 603 Contemporary Issues in Sociological Theory. (3) Prerequisite: One course in the history or development of sociological theory. Paradigm conflicts in Sociology such as that between Positivism and Humanism, between scientific and interpretive methods, between Marxism and Functionalism, etc. Examination of issues involved in differing theoretical viewpoints. Study of the intellectual, moral, and political problems involved in 'knowledge for its own sake,' and in 'knowledge for use.'

SOCY 606 Seminar in Field and Qualitative Methods. (3) Prerequisite: Six graduate level credits in Sociology and permission of instructor. Survey of qualitative research methods, and practice, through small scale field research, in design, collection of data, and analysis. Use of intensive and unstructured interviews; participation-observation; unobtrusive measures; content analysis of personal and public documents. Research with natural groups.

SOCY 609 Practicum in Social Research. (3) Prerequisite: Permission of instructor. The conduct of research in collection and analysis of Social Science data under the guidance of experienced investigators. Emphasis on a particular research area of procedure, e.g. secondary analysis of survey data; experimental design; evaluation of research; data collection techniques.

SOCY 618 Computer Methods for Sociologists. (3) Prerequisites: SOCY 400, 401 or equivalents and elementary knowledge of a programming language, CMSC 012, 020 or equivalent and consent of instructor. Designed to present the potential of the computer as a tool in sociological research. Projects involving programming and running of data manipulation techniques, statistical techniques, and simple simulations.

SOCY 620 Development of European and American Sociological Theory. (3) Prerequisite: SOCY 203 or consent of instructor. Review of the history of sociological thought with major attention to the key figures in the early years of the discipline (Marx, Weber, and Durkheim). The development of the major schools of sociological theory.

SOCY 621 Contemporary Sociological Theory. (3) Prerequisite: SOCY 203 or equivalent, or consent of instructor. Systematic examination of sociological theory since approximately 1920.

SOCY 622 The Sociology of Knowledge. (3) Analysis of the relation of types of knowledge to social structure. Role of social class and social organization in the development of science, political ideology, belief systems and social values. Social roles associated with production of knowledge.

SOCY 623 Survey of Urban Theory. (3) Prerequisite: SOCY 120, 473 or equivalnet. Theoretical approaches of sociology and other social sciences to urbanism, urbanization, and urban phenomena. Selected approaches: Chicago school; metropolitan region; demography; institutions.

SOCY 624 Socialization Theory and Research. (3) Emphasis on processes of theory building, utilizing research to compare the efficacy of several theories as they relate to socialization, culminating in a detailed theory of socialization and personality.

SOCY 625 Research Literature in Social Stratification. (3) Prerequisite: SOCY 441 or equivalent. A comprehensive review and detailed examination of the major theoretical and research problems in the sociology of social stratification. A critical review of the study of social stratification in American sociology. A detailed examination of the forms and functions, and the characteristics, correlates, and consequences of class and status stratification. The distribution of power. The relationship of social stratification to ideology and the institutional orders of the society.

SOCY 626 Human Ecology. (3) Review of research and theory in Human Ecology. Assessment of the ecological complex (population, organization, environment, technology).

SOCY 630 Population and Society. (3) Selected problems in the field of population; quantitative and qualitative aspects; American and world problems.

SOCY 631 Comparative Sociology. (3) Cross-national analysis of selected social institutions

SOCY 632 Personality and Social Structure. (3) First semester. Comparative analysis of the development of human nature, personality, and social traits in select social structures.

SOCY 633 Sociology of Occupations and Professions. (3) An analysis of the occupational and professional structures of American society, including such topics as changing roles, functions, ideologies and their impact on individuals.

SOCY 634 Attitudes and Public Opinion. (3) Precesses involved in the formation of attitudes; effects of communication; measurement techniques.

SOCY 635 Sociology of Law. (3)

SOCY 640 Social Change and Social Policy. (3) First semester. Emergence and development of social policy as related to social change, policy-making factors in social welfare and social legislation.

SOCY 641 Family Studies. (3) Second semester. Case studies of family situations; statistical studies of family trends, methods of investigation and analysis.

SOCY 642 The Sociology of Mental Health. (3) Social factors that influence mental health. Group dynamics of mental health preservation.

SOCY 643 Community Studies. (3) Factors affecting community development and growth, social structure, social stratification, social mobility and social institutions; analysis of particular communities.

SOCY 644 Work and the Family (3) The interrelationships between work and the family for both men and women in contemporary societies. Major research issues addressed from an interdisciplinary and comparative (international) perspective.

SOCY 645 Sociology of the Self Concept. (3) Theory and empirical research dealing with the social determination and social consequences of the self-concept. Sociological, psychological, and psychoanalytic approaches to the self.

SOCY 646 Collective Behavior and Social Movements. (3) Transitory and non-institutionalized social behavior; crowds, mass hysteria, panic, riots; secular and sectarian social reform movements; experimental utopian communities; intensified mass activity with particular relation to dissidence and change; critique of trends in social activism.

SOCY 647 Interpersonal Behavior and Small Groups. (3) Theory and empirical research on small group structure and processes and interpersonal behavior. Social influence, interpersonal attraction. Cohesiveness, power and prestige structures, role differentiation, coalition formation. Laboratory and field methods of investigation.

SOCY 650 Applied Sociology. (3) Introduction to the uses of Sociology in industrial and governmental settings. The ethics and social organization of sociological research, the development and evaluation of proposals, and budgeting research projects.

SOCY 660 Theories of Social Psychology. (3) Prerequisites: Undergraduate training in sociological research methods, statistics, and theory or equivalent. An introduction to some of the theories in Social Psychology that are particularly useful to sociologists. Topics to be covered include theories of cognitive consistency, social exchange, symbolic interaction, role theory, group processes, and collective behavior.

SOCY 661 Theories of Social Stratification. (3) Prerequisites: Undergraduate training in sociological research methods, statistics, and theory of equivalent. A critical examination of the major theoretical approaches developed for understanding societal stratification and social mobility. Consideration will be given to the writings, as well as the pertinent research literature, of Marx, Weber, Parsons, Davis, Moore, Dahrendorf, and Lenski. The works of other theorists, such as Blau and Duncan, Cooley, McClelland, Ososwski, Sorokin, Toennies, and Veblen, will be considered in accordance with the interests of students in the course.

SOCY 662 Theories of Formal Organization. (3) An introduction to the study of organization, the nature of organizations, types of organizations, determinants and consequences or organizational growth, determi-

nants and consequences of growth for administrative staff, determinants of effectiveness and research in organizations.

SOCY 663 Theories of Social Systems. (3) Prerequisite: SOCY 603 or equivalent. Study of: systems models—logical, social-psychological and social; types of social systems—ecological, functional, formal, consensual, and historical; levels of social systems—group, complex organization, collectivity and community; methods of study—analytical and empirical, qualitative and quantitative; examples of specific systems—professions, science, politics, cities.

SOCY 664 Armed Forces and Society. (3) Analysis of the relationship between military organization and modern industrial society. Growth and decline of the mass army, the transition from conscription to all-volunteer forces, the social legitimacy of military organization, the military as a form of industrial organization, and problems of civil-military relations in the modern world.

SOCY 674 Ethnicity. (3) The theoretical orientations found in the study of ethnicity, the historical emergence and contemporary nature of ethnic communities, selected aspects of interethnic conflict and ethnic revitalization from the personality level to the national ideological level. Primary emphasis on American society.

SOCY 699 Special Social Problems. (1–16)

SOCY 700 Theory Construction. (3) Prerequisite: One graduate course each in statistics, sociological theory, and sociological research methods. Review of symbolic logic and the meaning prediction and explanation. The nature of concepts propositions, and axiomatic systems; the use of models; the nature of casuality; fundamental assumptions and variables commonly used in sociological theory. Examples from current theories.

SOCY 701 Issues in Quantitative Methods. (3) Prerequisites: SOCY 401 or 601 or equivalent, and instructor's permission. An examination of current issues and problems in the application and interpretation of mathematical and statistical techniques in social research.

SOCY 702 Intermediate Procedures for Data Collection. (3) Prerequisite: SOCY 202 or equivalent, or consent of instructor. Research design including experimental and quasi-experimental designs; measurement problems; reliability and validity; questionnaire construction; scaling; interviewing; the problem of nonresponse; processing and coding of data; preparation of data for analysis.

SOCY 799 Master's Thesis Research. (1–6)

SOCY 899 Doctoral Dissertation Research. (1–8)

Spanish Language and Literature Program

SPANISH LANGUAGE AND LITERATURE PROGRAM

Professor and Chairman: Sosnowski
Professors: Goodwyn, Gramberg, Marra-Lopez, Nemes, Rama
Associate Professors: Igel, Rovner
Assistant Professor: Diz, Kliffer[1]

[1]joint appointment with French & Italian

The Department of Spanish and Portuguese offers graduate programs leading to the degrees of Master of Arts and Doctor of Philosophy in Spanish. The Department's offerings are designed to provide the required advanced training in language, literature, and linguistics for achieving professional excellence in high school and college teaching and for undertaking creative research in related fields of inquiry.

Admission and Degree Information

The degree of Master of Arts has two options: 1) the non-thesis option and 2) the thesis option. A total of 30 credit hours are required for the non-thesis option, with 3 credits in linguistics; 3 credits in literary theory and/or criticism; 15 credits in either Spanish or Spanish-American literature, one of which is to be considered the candidate's "major" literature; and 9 credits in the other, or "non-major" literature. Students must also submit a written scholarly paper in the final semester of their program, which will be read and evaluated by at least two appropriate faculty members.

The requirements for the thesis option are the same as for the non-thesis option, with one exception: the course requirement in the "major" literature is reduced from 15 to 9 credits, with 6 hours of thesis research credit required. All M.A. candidates take comprehensive examinations.

The doctoral degree is a research and specialized degree, and it does not require a fixed number of credit hours. Before admission to candidacy, the student must demonstrate 1) a thorough knowledge of the literary production in the chosen area (Spanish or Spanish-American Literature); 2) an in-depth knowledge of the field of specialization; 3) proficiency in a minimum of two fields of the other Hispanic literature; 4) a reading knowledge of a language other than Spanish and English, to be used as a research tool in the field of specialization; 5) a minimum of two courses in linguistics at the graduate level, one of which should be "History of the Spanish Language"; a minimum of one course in literary theory and/or criticism; acquaintance with a third literature (e.g. Luso-Brazilian, French, English, etc.); a background in supporting fields to be used as research tools (e.g. history, philosophy, political science, sociology, art, etc.). Students must pass both a preliminary and a comprehensive examination for the Ph.D., in addition to presenting a dissertation.

Facilities and Special Resources

The Department maintains a special research and reference library for graduate students of Spanish in honor of one of its former instructors, the late Pedro F. Entenza. The students publish a literary magazine, *Prismal/Cabral*. Dr. Sosnowski is the editor of the journal *Hispamerica*.

Additional Information

Financial assistance is available. For additional information please write to the Department Chairman.

Courses

Spanish

SPAN 401 Advanced Composition. (3) Exercises in practical stylistics, with special emphasis on idiomatic and syntactic structures.

SPAN 402 Advanced Composition. (3) Exercises in practical stylistics, with special emphasis on idiomatic and syntactic structures.

SPAN 404 Oral Practice for Non-Native Teachers of Spanish I. (3) Prerequisite: Consent of instructor. Development of fluency in Spanish with stress on correct sentence structure, pronounciation and idiomatic expression.

SPAN 405 Oral Practice for Non-Native Teachers of Spanish II. (3) Prerequisite: SPAN 404. A continuation of SPAN 404.

SPAN 408 Great Themes of the Hispanic Literatures. (3) Pervading themes in the literature of Spain or Spanish-America. Each theme will be announced when the course is offered.

SPAN 409 Great Themes of the Hispanic Literatures. (3) Pervading themes in the literature of Spain or Spanish-America. Each theme will be announced when the course is offered.

SPAN 410 Literature of the Middle Ages. (3) Spanish literary history from the eleventh through the fifteenth century. Reading of representative texts. This course covers until 1350.

SPAN 411 Literature of the Middle Ages. (3) Spanish literary history from the eleventh through the fifteenth century. Reading of representative texts. This course covers from 1350 to 1500.

SPAN 412 The Romancero. (3) Origin, nature and influence. Extensive reading in each of the respective sub-genres.

SPAN 418 Hispanic Literature in Translation. (3) May be repeated to a maximum of six credits, with change of topic.

SPAN 420 Poetry of the 16th Century. (3) Prerequisite: SPAN 321 or equivalent. Selected readings and literary analysis.

SPAN 421 Prose of the 16th Century. (3) Prerequisite: SPAN 321 or equivalent. Selected readings and literary analysis.

SPAN 424 Drama of the Sixteenth Century. (3) From the earliest Autos and Pasos, the development of Spanish drama anterior to Lope de Vega, including Cervantes.

SPAN 425 Spanish Civilization. (3) A survey of 2000 years of Spanish history, outlining the cultural heritage of the Spanish people, their great men, traditions, customs, art, and literature, with special emphasis on the interrelationship of social and literary history. Conducted in Spanish.

SPAN 426 Spanish Civilization. (3) A survey of 2000 years of Spanish history, outlining the cultural heritage of the Spanish people, their great men, traditions, customs, art, and literature, with special emphasis on the interrelationship of social and literary history. Conducted in Spanish.

SPAN 430 Cervantes-Don Quijote. (3) Prerequisite: SPAN 321 or equivalent.

SPAN 431 Cervantes—Novelas Ejemplares and Entremeses. (3) Prerequisite: SPAN 321 or equivalent.

SPAN 434 Poetry of the 17th Century. (3) Prerequisite: SPAN 321 or equivalent. Selected readings, literary analysis, and discussion of the outstanding poetry of the period, in the light of the historical background.

SPAN 435 Prose of the 17th Century. (3) Prerequisite: SPAN 321 or equivalent. Selected readings, literary analysis, and discussion of the outstanding prose of the period, in the light of the historical background.

SPAN 436 Drama of the Seventeenth Century. (3) Devoted to Lope de Vega, dramatic theory and the Spanish stage.

SPAN 437 Drama of the Seventeenth Century. (3) Drama after Lope de Vega to Calderon de La Barca and the decline of the Spanish theater.

SPAN 440 Literature of the Eighteenth Century. (3) Traditionalism, Neo-Classicism, and Pre-Romanticism in prose, poetry, and the theater; esthetics and poetics of the Enlightenment.

SPAN 441 Literature of the Eighteenth Century. (3) Traditionalism, Neo-Classicism, and Pre-Romanticism in prose, poetry, and the theater; esthetics and poetics of the Enlightenment.

SPAN 446 Latin American Civilization I. (3) A survey of the cultural heritage of the Latin American peoples from the Pre-Columbian Period to Independence. Hispanic and other European influences. Conducted in Spanish.

SPAN 447 Latin American Civilization II. (3) A survey of the cultural heritage of the Latin American peoples from Independence to the present. Hispanic and other European influences. Conducted in Spanish.

SPAN 448 Special Topics in Latin American Civilization. (3) An intensive study of a selected topic related to Latin American Civilization. This course may be taken no more than twice. Conducted in Spanish.

SPAN 449 Special Topics in Spanish Civilization. (3) An intensive study of a selected topic related to Spanish Civilization. Repeatable to a maximum of six credits if content differs.

SPAN 452 The Romantic Movement in Spain. (3) Poetry, prose and drama of the Romantic and Post-Romantic Periods.

SPAN 454 Nineteenth Century Fiction. (3) Significant novels of the nineteenth century.

SPAN 456 Nineteenth Century Drama and Poetry. (3) Significant dramas and poetry of the Realistic Period.

SPAN 460 The Generation of 1898 and Its Successors. (3) Authors and works of all genres of the Generation of 1898 and those of the immediately succeeding generation.

SPAN 461 The Generation of 1898 and its Successors. (3) Authors and works of all genres of the Generation of 1898 and those of the immediately succeeding generation.

SPAN 462 Twentieth Century Drama. (3) Significant plays of the twentieth century.

SPAN 464 Contemporary Spanish Poetry. (3) Spanish poetry from the generation of 1927 to the present.

SPAN 466 The Contemporary Spanish Novel. (3) The novel and the short story from 1940 to the present.

SPAN 468 Modernism and Post-Modernism in Spain and Spanish-America. (3) A study of the most important works and authors of both movements in Spain and Spanish-America.

SPAN 469 Modernism and Post-Modernism in Spain and Spanish-America. (3) A study of the most important works and authors of both movements in Spain and Spanish-America.

SPAN 480 Spanish-American Essay. (3) A study of the socio-political contents and aesthetic qualities of representative works from the Colonial to the Contemporary Period.

SPAN 481 Spanish American Essay. (3) A study of the socio-political contents and aesthetic qualities of representative works from the Colonial to the Contemporary Period, with emphasis on the essay of the twentieth century.

SPAN 488 Spanish-American Fiction. (3) Representative novels and/or short stories from the Wars of Independence to the present or close analysis of major contemporary works. Subject will be announced each time course is offered.

SPAN 489 Spanish-American Fiction. (3) Representative novels and/or short stories from the Wars of Independence to the present or close analysis of major contemporary works. Subject will be announced each time course is offered.

SPAN 491 Honors Reading Course—Poetry. (3) H—Honors. Supervised reading to be taken by students admitted to the Honors Program or upon consultation with the instructor.

SPAN 492 Honors Reading Course—Novel. (3) H—Honors. Supervised reading to be taken by students admitted to the Honors Program or upon consultation with the instructor.

SPAN 493 Honors Reading Course—Drama. (3) H—Honors. Supervised reading to be taken by students admitted to the Honors Program or upon consultation with the instructor.

SPAN 496 Honors Seminar. (3) H—Honors. Required of all students in the Honors Program. Other students will be admitted on special recommendation. Conducted in Spanish. Discussion of a central theme with related investigation by students.

SPAN 498 Spanish-American Poetry. (3) Main trends, authors and works from the conquest to Ruben Dario.

SPAN 600 Reading Course for Minors in Spanish. (3)

SPAN 601 Reading Course for Minors in Spanish. (3)

SPAN 602 Reading Course for Minors in Spanish-American Literature. (3)

SPAN 603 Reading Course for Minors in Spanish-American Literature. (3)

SPAN 605 Teaching Spanish in Institutions of Higher Learning. (3) Required of all graduate students, teaching assistants, and new instructors. Instruction, demonstration, and classroom practice under supervision, of modern procedures in the presentation of first year Spanish.

SPAN 608 Medieval Spanish Literature. (3) Specific authors, genres, and literary periods studied in depth.

SPAN 609 Medieval Spanish Literature. (3) Specific authors, genres, and literary periods studied in depth.

SPAN 610 The History of the Spanish Language. (3)

SPAN 611 Applied Linguistics. (3) Nature of Applied Linguistics and its contribution to the effective teaching of foreign languages. Comparative study of English and Spanish, with emphasis on points of divergence.

SPAN 612 Comparative Romance Linguistics. (3)

SPAN 618 Poetry of the Golden Age. (3) Analysis and studies in depth of specific works of specific poets in the sixteenth and seventeenth centuries.

SPAN 619 Poetry of the Golden Age. (3) Analysis and studies in depth of specific works of specific poets in the sixteenth and seventeenth centuries.

SPAN 628 Seminar—The Golden Age in Spanish Literature. (3)

SPAN 629 Seminar—The Golden Age in Spanish Literature. (3) Specific authors, genres, literary movements and literary periods of the sixteenth and seventeenth centuries studied in depth.

SPAN 699 Independent Study in Spanish. (1–3) This course is designed to provide graduate students an opportunity to pursue independent study under the supervision of a member of the department. Repeatable to a maximum of three credits.

SPAN 708 The Eighteenth Century. (3) Specific authors, genres, and literary movements studied in depth.

SPAN 709 The Eighteenth Century. (3) Specific authors, genres, and literary movements studied in depth.

SPAN 718 The Nineteenth Century. (3) Specific authors, genres, and literary movements studied in depth.

SPAN 719 **The Nineteenth Century. (3)** Specific authors, genres, and literary movements studied in depth.

SPAN 728 The Twentieth Century. (3) Specific authors, genres and literary movements studied in depth.

SPAN 729 The Twentieth Century. (3) Specific authors, genres and literary movements studied in depth

SPAN 738 The Drama of the Twentieth Century. (3) Specific authors and movements studied in depth.

SPAN 798 Open Seminar. (3)

SPAN 799 Master's Thesis Research. (1–6)

SPAN 808 Colonial Spanish-American Literature. (3) Didactic and narrative prose and epic, dramatic and lyric poetry; principal works and authors.

SPAN 809 Colonial Spanish American Literature. (3) Didactic and narrative prose; dramatic and lyric poetry.

SPAN 818 National Spanish-American Literature. (3) Characteristics of the national literatures. Romantic and Costumbrista literature. Cauchismo and Indigenismo. Principal works and authors.

SPAN 819 National Spanish American Literature. (3) Characteristics of the national literatures. Romantic and Costumbrista literature. Cauchismo and Indigenismo. Principal works and authors.

SPAN 828 Hispanic Poetry of the Nineteenth and Twentieth Centuries. (3) Specific authors, genres and literary movements studied in depth.

SPAN 829 Hispanic Poetry of the Nineteenth and Twentieth Centuries. (3) Specific authors, genres and literary movements studied in depth.

SPAN 898 Open Seminar. (3)

SPAN 899 Doctoral Dissertation Research. (1–8)

PORTUGUESE

PORT 478 Themes and Movements of Luso-Brazilian Literature in Translation. (3) A study of specific themes and movements in Luso-Brazilian literature, as announced. Designed for students for whom the literatures would be inaccessible in Portuguese. Repeatable to a maximum of six credits.

PORT 699 Independent Study of Portuguese. (1–3) This course is designed to provide graduate students an opportunity to pursue independent study under the supervision of a member of the department. Repeatable to a maximum of three credits.

Special Education Program

Professor and Chairman: Burke
Professors: Hebeler, Simms
Associate Professor: Seidman
Assistant Professors: Blair, Certo, Egel, Harber, Kohl, Lee[1] Malouf, McNelly, Shroyer, Spekman[1]Joint appointment with early childhood, elementary education.

Graduate studies in the Department of Special Education include programs leading to Master of Arts and Master of Education degrees, Advanced Graduate Specialist certificates, and Doctor of Education and Doctor of Philosophy degrees. Areas of concentration may include: integrated special education; educational diagnosis and prescription; mental retardation; education of the gifted; education of the emotionally disturbed, severely/profoundly handicapped; pre-school and early childhood learning disabilities; and career-vocational-secondary education for the handicapped.

Graduate work in special education at the master's level is designed to prepare master teachers, specialists, and program leadership personnel for the handicapped.

Graduate work at the doctoral level is designed to prepare national leadership personnel for the handicapped in areas of research and teacher training; research and leadership in educational administration and supervision; and policy development and implementation for the handicapped with a specialized national focus. Studies in administration and policy development are available with selective augmentation in appropriate academic areas.

Admission and Degree Information

Graduate programs are planned individually by the student with his advisor. Each program reflects the individual student's background, his goals and the level of competency being sought. There is no one program of study which all graduate students follow. Individual programming by students and advisor allows wide latitude of career direction within the field of special education upon completion of graduate study.

Graduate study in Special Education requires advanced competencies in the education of exceptional children. Students must have undergraduate preparation and/or certification prior to entry to the graduate program. Students without graduate or undergraduate preparation in special education should expect more extensive graduate programs so that they might develop the necessary levels of competence.

Students pursuing the master's degree program in Special Education may earn the Master of Arts degree or the Master of Education degree. Specific basic course requirements in Special Education are the same for either program with differentiation of thesis requirements. The following core courses are required for completion of the master's level program: EDMS 446, EDMS 646, and EDHD 721.

The minimum number of graduate hours for the master's degree program is 30. The student generally takes a minimum of 9 to 15 hours in Special Education. Specific programs and the number of credit hours required will be determined with the student's advisor according to the student's background and career plans.

The Advanced Graduate Specialist certificate in Special Education is available to students wishing to take increased graduate work beyond the Masters level. A student pursuing an A.G.S. certificate in Special Education is required to take the following courses if they

have not been part of his Master's program: EDMS 446, EDMS 646, and EDHD 721. The minimum number of graduate hours for the A.G.S. is 60. The core of the program should be made up of Special Education courses and other work within the College of Education or other Colleges of the University as approved by the student's advisor and the Special Education Graduate Faculty.

Students pursuing the doctoral program in Special Education must have completed the Master of Arts degree or the Master of Education degree and may elect to work for either the Ed.D. or Ph.D. degree. Students should consult the Department Statement on Graduate Programs. A student in the doctoral program will generally complete a minimum of 90 hours of graduate study of which 30–40 hours will be in his major field.

A candidate must develop doctoral level competencies in research and in any of the areas of specialization (listed above) which fulfill his professional goals.

Facilities and Special Resources

Special strengths of the Special Education program include the focus on integrated field experiences, the utilization of the Special Education Resource Laboratory which houses related materials, and the wide backgrounds of faculty members which enables the Department to maintain an integrated approach.

Additional Information

Prospective graduate students are requested to consult "Graduate Programs in Special Education," which is avilable in the departmental offices, for additional specific information on departmental programs, admissions procedures and financial aid.

Courses

EDSP 470 Introduction to Special Education. (3) Prerequisite: EDSP 288. Designed to give an understanding of the needs of all types of exceptional children. Stressing preventive and remedial measures.

EDSP 471 Characteristics of Exceptional Children—Mentally Retarded. (3) Prerequisite: EDSP 470 or equivalent. Studies the diagnosis etiology, physical, social and emotional characteristics of exceptional children.

EDSP 472 Education of Exceptional Children—Mentally Retarded. (3) Prerequisite: EDSP 471 or equivalent. Offers practical and specitic methods of teaching exceptional children. Selected observation of actual teaching may be arranged.

EDSP 473 Curriculum for Exceptional Children—Mentally Retarded. (3) Prerequisite: EDSP 471 or equivalent. Examines the principles and objectives guiding curriculum for exceptional children; gives experience in developing curriculum; studies various curricula currently in use.

EDSP 475 Education of the Slow Learner. (3) Studies the characteristics of the slow learner and those educational practices which are appropriate for the child who is functioning as a slow learner.

EDSP 481 Characteristics of Exceptional Children—Gifted. (3) Prerequisite: EDSP 470 or equivalent. Studies the diagnosis, etiology, physical, social, and emotional characteristics of exceptional children.

EDSP 482 Education of Exceptional Children—Gifted. (3) Prerequisite: EDSP 481 or equivalent. Offers practical and specilic methods of teaching exceptional children. Selected observation of actual teaching may be arranged.

EDSP 483 Curriculum for Exceptional Children—Gifted. (3) Prerequisite: EDSP 481 or equivalent. Examines the principles and objectives guiding current curriculum for exceptional children; gives experience in developing curriculum; studies various curricula currently in use.

EDSP 489 Field Experience in Special Education. (1–4) Prerequisite: At least six semester hours in Special Education at the University of Maryland plus such other prerequisites as may be set by the Special Education department. Planned field experience may be provided for selected students who have had teaching experience or, who, have been approved by the Special Education faculty. Note: The total number of credits which a student may earn in EDSP 489, 888, and 889 is limited to a maximum of 20 semester hours.

EDSP 491 Characteristics of Exceptional Children—Perceptual Learning Problems. (3) Prerequisite: EDSP 470 or equivalent. Studies the diagnosis, etiology, physical, social, and emotional characteristics of exceptional children.

EDSP 492 Education of Exceptional Children—Perceptual Learning Problems. (3) Prerequisite: EDSP 491 or equivalent. Offers practical and specilic methods of teaching exceptional children. Selected observation of actual teaching may be arranged.

EDSP 493 Curriculum for Exceptional Children—Perceptual Learning Problems. (3) Prerequisite: EDSP 492 or equivalent. Examines the principles and objectives guiding curriculum for exceptional children; gives experience in developing curriculum; studies various curricula currently in use.

EDSP 498 Special Problems in Special Education. (1–3) Prerequisite: Consent of instructor. Available only to mature students who have definite plans for individual study of approved problems.

EDSP 499 Workshops, Clinics, and Institutes in Special Education. (1–6) The maximum number of credits that may be earned under this course symbol toward any degree is six semester hours; the symbol may be used two or more times until six semester hours have been reached the following type of educational enterprise may be scheduled under this course heading: workshops conducted by the Special Education Department (or developed cooperatively with other departments, colleges and universities) and not otherwise covered in the present course listing. Laboratories, and Special Education centers; institutes developed around specific topics or problems and intended for designated groups such as school superintendents, principals and supervisors.

EDSP 600 Exceptional Children and Youth. (3) Prerequisite: 9 hours in Special Education and consent of instructor. Deals primarily with research relevant to the intellectual, psychological, physical, and emotional charateristics of exceptional children.

EDSP 601 Emotionally Handicapped Children and Youth. (3) Prerequisite: EDSP 600 and consent of instructor. Deals with epidemeology, etiology, classification, diagnostic procedures, behavioral characteristics, treatment and prevention of child and adolescent disturbances.

EDSP 605 The Exceptional Child and Society. (3) Prerequisite: EDSP 600 or consent of instructor. Relationship of the role and adjustment of the child with an exceptionality to societal characteristics.

EDSP 610 Administration and Supervision of Special Education Programs. (3) Prerequisite: EDSP 600 and consent of instructor. Consideration of the determination, establishment and function of educational programs to exceptional children for administrative and supervisory personnel.

EDSP 615 Evaluation and Measurement of Exceptional Children and Youth. (3) Prerequisite: EDMS 446, 646, and EDSP 600. Deals with the understanding and interpretation of the results of psychological and educational tests applicable for use with exceptional children.

EDSP 620 Educational Diagnosis and Planning for Exceptional Children and Youth (3) Prerequisite: EDSP 615. Deals with the identification of learning characteristics of exceptional children and the planning of appropriate programs.

EDSP 621 Psycho-Educational Programming with Emotionally Handicapped Children and Youth. (3) Prerequisite: EDSP 600, 601 and consent of instructor. Deals with factors pertinent to therapeutic education of disturbed children and adolescents in special treatment settings.

EDSP 625 Problems in the Education of the Mentally Retarded. (3) Prerequisite: 9 hours EDSP including EDSP 600 or consent of instructor. Consideration of the pertinent psychological, educational, medical, sociological and other research and theoretical material relevant to the determination of trends, practices, regarding the mentally retarded.

EDSP 630 Problems in the Education of the Gifted. (3) Prerequisite: 9 hours EDSP including EDSP 600 or consent of instructor. Consideration of the pertinent psychological, educational, medical, sociological and other relevant research and theoretical material relevant to the determination of trends, practices, regarding the gifted.

EDSP 635 Problems in the Education of Children with Emotional Disturbances. (3) Prerequisite: 9 hours EDSP including EDSP 600 or consent of instructor. Consideration of the pertinent psychological, educational, medical, sociological and other research and theoretical material relevant to the determination of trends, practices, regarding the emotionally disturbed.

EDSP 640 Problems in the Education of Children with Perceptual Impairment. (3) Prerequisite: 6 hours in Education of the perceptually impaired, EDSP 615 and 620 or consent of instructor. Consideration of the pertinent psychological, educational, medical, sociological and other research and theoretical material relevant to the determination of trends, practices, regarding the perceptually impaired.

EDSP 678 Seminar in Special Education. (3)

EDSP 798 Special Problems in Education. (1–6) Master's AGS, or doctoral candidates who desire to pursue special research problems under the direction of their advisors may register for credit under this number.

EDSP 799 Master's Thesis Research. (1–6) Registration required to the extent of six hours for master's thesis.

EDSP 888 Apprenticeship in Special Education. (1–8) Apprenticeships in the major area of study are available to selected students whose application for an apprenticeship has been approved by the Education faculty. Each apprentice is assigned to work for at least a semester full-time or the equivalent with an appropriate staff member of a cooperating school, school system, or educational institution or agency. The sponsor of the apprentice maintains a close working relationship with the apprentice and the other persons involved. Prerequisites: Teaching experience, a Master's degree in Education, and at least six semester hours in Education at the University of Maryland. Note: The total number of credits which a student may earn in EDSP 489, 888, and 889 is limited to a maximum of twenty (20) semester hours.

EDSP 889 Internship in Special Education. (3–8) Internships in the major area of study are available to selected students who have teaching experience. The following groups of students are eligible: (a) Any student who has been advanced to candidacy for the doctor's degree; and (b) Any student who receives special approval by the Education faculty for an internship, provided that prior to taking an internship, such student shall have completed at least 60 semester hours of graduate work, including at least six semester hours in Education at the University of Maryland. Each intern is assigned to work on a full-time basis for at least a semester with an appropriate staff member in a cooperating school, school system, or educational institution or agency. The internship must be taken in a school situation different from the one where the student is regularly employed. The intern's sponsor maintains a close working relationship with the intern and the other persons involved. Note: The total number of credits which a student may earn in EDSP 489, 888, and 889 is limited to a maximum of twenty (20) semester hours.

EDSP 899 Doctoral Dissertation Research. (1–8) Registration required to the extent of 6–9 hours for an Ed.D. project and 12–18 hours for a Ph.D. dissertation.

Textiles and Consumer Economics Program

Professor and Chairman: Smith
Professor: Dardis
Associate Professors: Block, Buck, Spivak, Yeh
Assistant Professors: Brannigan, Brinberg, Derrick, Hacklander, Jensen
Visiting Assistant Professor: Harris
Visiting Professor: Hollies

The Department of Textiles and Consumer Economics offers programs of study leading to the

Master of Science and Doctor of Philosophy degrees. Fields of specialization are TEXTILES and/or CONSUMER ECONOMICS. In the field of textiles, students may concentrate in textile science, textile economics and marketing, clothing and human behavior, or historic textiles and costume. In the field of consumer economics, students may concentrate in consumption economics, consumer policy, consumer behavior, or consumer technology.

Admission and Degree Information

There are no rigid course requirements for admission to the graduate program in Textiles and Consumer Economics. A major in Home Economics, Consumer Economics, Textiles and Clothing, Textiles, or a relevant discipline such as chemistry, economics, or psychology is acceptable as background for study in this field. Preparation in the basic physical and social sciences (chemistry, mathematics, economics, psychology, and sociology) is highly recommended. Necessary course prerequisites (without graduate credit) can be completed after admission to the graduate program. All applicants are required to submit scores of the Graduate Record Examination Aptitude Test.

Thesis and non-thesis options are available for the Master of Science degree. In the thesis option, students must complete a minimum of 24 hours of course work, a thesis, and pass a final oral examination on the thesis. In the non-thesis option, students must complete a minimum of 30 hours of course work, submit one scholarly paper, and pass a written comprehensive final examination. Students in both the thesis and non-thesis options must present one departmental seminar.

Students with bachelor's degrees may apply for the doctoral program although they are encouraged to complete requirements for the M.S. degree. Applicants holding a master's degree in an equivalent field from an accredited institution may be admitted for immediate doctoral study. Previous graduate work will be evaluated on an individual basis, but a minimum of 18 hours of course work beyond the master's level is required for the Ph.D. degree in addition to 12 hours of dissertation research. Qualifying examinations are administered upon completion of basic course requirements in either textiles or consumer economics. Written and oral comprehensive examinations are given upon completion of all course work. A final oral examination is held for the student to defend the dissertation.

Facilities and Special Resources

The graduate program is multidisciplinary in nature with graduate faculty from chemistry, engineering, economics, behavioral sciences, and the arts. Departmental research facilities include the historic textiles and costume collection, a full range of equipment for textile research with special emphasis on flammability, and a Wang minicomputer. Access to federal agencies where decisions affecting consumers are made provides graduate students with a unique opportunity to conduct consumer related research.

Financial Assistance

Graduate teaching and/or research assistantships are offered to qualified applicants on the basis of past academic performance and experience. More than half of the full-time students in the Department hold assistantships or some form of financial aid. Part-time and summer work is often available for students not receiving financial aid.

Additional Information

Additional information on departmental programs, admissions, procedures and financial aid may be obtained by contacting: Chairman, Department of Textiles and Consumer Economics, Room 3017 Turner Laboratory, University of Maryland, College Park, Maryland 20742.

Courses

Consumer Economics

CNEC 400 Research Methods. (3) Prerequisite: MATH 110 or 115. Research methodology in Textiles and Consumer Economics, with particular emphasis on the application of statistical concepts and techniques to the analysis of data from the areas of Textiles and Consumer Economics. May not be taken by students who have credit in TEXT 400.

CNEC 431 The Consumer and the Law. (3) Three lectures a week. A study of legislation affecting consumer goods and services. Topics covered include product safety and liability, packaging and labeling, deceptive advertising, and consumer credit. The implications of such legislation for consumer welfare with particular emphasis on the disadvantaged groups in our society will be examined.

CNEC 433 Consumer Law—Advertising and Solicitation. (3) Prerequisite—CNEC 431 or consent of instructor. An advanced study of the legal consequences of inducing consumers to enter into commercial transactions. Individual consumer remedies, collective consumer remedies and government regulation.

CNEC 435 Economics of Consumption. (3) Spring semester. Three lectures per week. Prerequisites: ECON 201 and 203 or ECON 205 for non-majors. The application of economic theory to a study of consumer decision-making and its role in a market economy at both the individual and aggregate levels. Topics covered include empirical studies of consumer spending and saving, the consumer in the market and collective consumption.

CNEC 437 Consumer Behavior. (3) Three lectures per week. Prerequisites: PSYC 100 and SOCY 100. An application of the behavioral sciences to a study of consumer behavior. Current theories, models and empirical research findings are explored.

CNEC 455 Consumer Technology: Product Standards. (3) Prerequisite: Consent of instructor. The process of product standard development, and the significance of such standards to the consumer. History, procedures and uses of standards by industry and government, including both voluntary and regulatory standardization; the impact of product standards, and mechanisms for obtaining consumer imput in the standardization process.

CNEC 456 Consumer Technology: Product Liability and Government Regulations. (3) Prerequisite: CNEC 431 or consent of instructor. Legal concepts involved in society's determination of consumer's rights to product safety. Litigation determining the obligation of manufacturers and sellers to injured consumers. Government regulations defining the obligations of manufacturers to design and construct products in accordance with government standards.

CNEC 457 Consumer Technology—Product Safety. (3) Prerequisite: Consent of instructor. An interdisciplinary investigation of consumer product safety. Major statutes and agencies regulating safety. Alternative means of promoting consumer product safety. The application of product liability and cost benefit analysis to the economics of product safety. Consumer response to safety labeling, advertising and educational efforts.

CNEC 488 Senior Honors Thesis. (1–4) Limited to undergraduate students in the departmental honors program. An independent literary, laboratory or field study, conducted throughout the student's senior year. Student should register in both fall and spring.

CNEC 498 Special Studies. (2–4) Independent study by an individual student or by a group of students in advanced work not otherwise provided in the department. Students must prepare a description of the study they wish to undertake. The plan must be approved by the faculty directing the study and the department chairman.

Textiles

TEXT 400 Research Methods. (3) Prerequisite: MATH 110 or 115. Research methodology in Textiles and Consumer Economics, with particular emphasis on the application of statistical concepts and techniques to the analysis of data from the areas of Textiles and Consumer Economics. May not be taken by students who have credit in CNEC 400.

TEXT 420 Apparel Design—Draping. (3) Two three-hour laboratory periods per week. Prerequisites: APDS 101 and TEXT 222 APDS 220 recommended but not required. Students explore pattern design through draping on the human form. Emphasis is on the interrelationship between material, design and form.

TEXT 425 Apparel Design—Experimental Processes. (3) Two three-hour laboratory periods per week. Prerequisites: APDS 101, TEXT 250, and TEXT 222. Processes are related to fiber and fabric characteristics, style and end-use. Opportunities are provided for students to: 1) learn advanced construction and tailoring techniques 2) explore, adapt and create new processes with modern textile materials and 3) evaluate results in terms of design quality.

TEXT 441 Clothing and Human Behavior. (3) Three lectures per week. Prerequisites: PSYC 100 and SOCY 100. An exploration of socio-psychological approaches to the study of clothing in relation to human behavior. Social and psychological theories will be examined as possible framework for the study and investigation of clothing.

TEXT 445 History of Costume I. (3) Three lectures per week. The wrap-style dress. A critical study of the various forms of dress; analyzing shape and form of garments and the component parts of which they are made, taking special note the various distinctive styles and unique shapes which help distinguish one period from another; relating the history of costume to events, to achievements, to the social attitudes and development of the various times and cultures of man.

TEXT 447 History of Costume II. (3) Three lectures per week. The shaped-style dress. A critical study of the various forms of dress; analyzing shape and form of garments and the component parts of which they are made, taking special note of the distinctive styles and unique shapes which help distinguish one period from another; relating the history of costume to events, to achievements, to the social attitudes and development of the various times and culture of man.

TEXT 452 Textile Science—Chemical Structures and Properties of Fibers. (3) Two lectures and one three-hour laboratory per week. Prerequisites: CHEM 104 or consent of instructor. The chemical structure, properties and reactions of the major classes of natural and man-made fibers. Emphasis is placed upon the relationship between molecular structure and physical properties of fibers and fabrics. Laboratory includes chemical identification of fibers, preparation of selected fibers and examination of chemical reactions and properties of fibers.

TEXT 454 Textile Science—Finishes. (3) Two lectures and one three-hour laboratory per week. Prerequisite: TEXT 452 or consent of instructor. A study of the chemical reactions and mechanisms involved in imparting water repellance, crease resistance and crease recovery properties, shrink-resistance, flame resistance, soil-release properties and moth and mildew resistance to textile materials. Properties of the finished material which effect its end-use will also be examined. Laboratory work includes the application of finishes, identification of finishes and a study of the properties of finished fabrics.

TEXT 456 Textile Science—Chemistry and Physics of Fibers and Polymers. (3) Two lectures and one three-hour laboratory per week. Prerequisite: Consent of instructor. The theory of fiber structure and its relationship to chemical and physical properties of natural and man-made fibers. Laboratory includes study of performance of textile materials in relation to their chemical and physical properties.

TEXT 463 History of Textiles. (3) Three lectures per week. Prerequisite: TEXT 150 or consent of instructor. A study of historic and contemporary fibers and fabrics. Emphasis will be placed on the analysis of designs and techniques of decorating fabrics and the relationship of textiles to the aesthetic and developmental cultures of society.

TEXT 465 Economics of the Textile and Apparel Industries. (3) Three lectures per week. Prerequisites: ECON 201 and 203. Trends in the production and

consumption of textiles and apparel; economic analysis of the textile and apparel industries; factors affecting changes in output, price, location and market structure.

TEXT 488 Senior Honors Thesis. (1–4) Limited to undergraduate students in the departmental Honors Program. An independent literary, laboratory of field study, conducted throughout the student's senior year. Student should register in both fall and spring.

TEXT 498 Special Studies. (2–4) Independent study by an individual student or by a group of students in advanced work not otherwise provided in the department. Students must prepare a description of the study they wish to undertake. The plan must be approved by the faculty directing the study and the department chairman.

Textiles and Consumer Economics

TXCE 600 Research Methods. (3) Prerequisite: An introductory course in Statistics. Research methodology in Textiles and Consumer Economics. The relationship between statistics and research; experimental techniques and methods for data collection and analysis. Each student is required to prepare a research proposal.

TXCE 608 Special Problems. (1–3) Credit according to time scheduled and organization of the course. The course may be organized as a lecture series on a specialized advanced topic or may consist of an experimental problem other than the student's thesis topic. Maximum credit allowed toward an advanced degree shall not exceed six hours.

TXCE 610 Consumer Economics I—Consumer Choice in the American Economy. (3) Prerequisite: CNEC 435 or ECON 403 or consent of instructor. An economic analysis of consumer decision-making at the individual and aggregate levels. The economic theory of consumer behavior and its relationship to market demand; consumer rights in the market and methods for ensuring such rights; income distribution and income maintenance programs; consumer expenditures in the U.S., and collective consumption.

TXCE 611 Consumer Economics II—Applied Consumption Analysis. (3) Prerequisite: TXCE 610 or consent of instructor. The application of the economic theory of consumer behavior to the measurement of consumer demand. Emphasis on the allocation of total consumption by categories of consumption rather than on the determination of total consumption and saving. Engel curves and demand studies based on time series data are discussed.

TXCE 620 Consumer Behavior I—Theory Development. (3) Prerequisite: CNEC 437 or consent of instructor. An application of the behavioral sciences to a study of consumer behavior. Identification and critique of current theories of consumer behavior.

TXCE 621 Consumer Behavior II—Model Construction and Testing. (3) Prerequisite: TXCE 620 or consent of instructor. A systematic approach to the construction and testing of consumer behavior models. Selected specialized techniques for consumer behavior research based on various consumer behavior models.

TXCE 638 Advanced Topics in Consumer Economics (2–3) A lecture/discussion series on a specialized advanced topic. Course may be repeated for a maximum of six credits.

TXCE 639 Seminar in Consumer Economics (1–3) A critical discussion of current research literature in the field. Course may be repeated for a maximum of six credits.

TXCE 647 Clothing and Comfort. (3) Prerequisite: TEXT 250 or consent of instructor. An examination of the physical, psychological and environmental factors which affect the physiological response of the human body to the clothing microclimate.

TXCE 648 Seminar in Historic Textiles. (1–3) In depth studies of selected areas of historic textiles and/or historic textile products, together with their relationships to the cultures and societies of man. Maximum credit allowed toward an advanced degree shall not exceed six hours.

TXCE 649 Seminar in Clothing and Human Behavior. (3) An examination of theories and research concerned with the relation between clothing and human behavior. Special emphasis will be placed on research techniques. Maximum credit allowed toward an advanced degree shall not exceed six hours.

TXCE 650 Seminar in Textile Economics and Marketing. (3) A critical review of research literature in the economics of the textile and apparel industries and the marketing of textile products. The application of research methods to current problems of the textile and apparel industries will be discussed.

TXCE 658 Advanced Topics in Textiles (2–3) A lecture/discussion series on a specialized advanced topic. Course may be repeated for a maximum of six credits.

TXCE 659 Seminar in Textile Science. (1–3) A critical discussion of current research literature in the field.

TXCE 660 Textile Science I. (3) Prerequisite: TEXT 452 or consent of instructor. A study of the chemical and physical structure of fiber-forming polymers as they affect the performance of textile materials. Emphasis on structure/property relationships.

TXCE 661 Textile Science II. (3) Prerequisite: TEXT 660 or consent of instructor. Examination of the principles and techniques of dyeing and finishing textile products. Properties of the finished products which affect their end-use.

TXCE 670 Textile Evaluation I. (3) Prerequisite: TEXT 250 or consent of instructor. Two lectures and one three-hour laboratory per week. In-depth study of the principles and concepts involved in the laboratory evaluation of textile and related materials. The influence of testing parameters and methodology on selected major aspects of textile performance will be considered.

TXCE 671 Textile Evaluation II. (3) Prerequisite: TXCE 670. A continuation of Textile Evaluation I.

TXCE 699 Research Seminar. (1) Seminars on various topics in Textiles and Consumer Economics. Colloquia by graduate students, faculty and visiting speakers. Course may be repeated for a maximum of two credits.

TXCE 710 Public Policy and Consumer Economics. (3) Prerequisite: ECON 403 or consent of instructor. The application of economic theory to an evaluation of policy decisions which affect the consumer. The economic, social and political framework within which policy decisions are made. Consumer protection programs in the private and public sectors.

TXCE 770 Textile Microscopy (3) Two hours of lecture and four hours of laboratory per week. The theory and practice of fiber and textile microscopy.

TXCE 799 Master's Thesis Research. (1–6)

TXCE 899 Doctoral Disseratation Research. (1–8)

Urban Studies Program

Director and Associate Professor: Levine
Professors: Janes, Marando
Associate Professors: Bish, Stone
Assistant Professors: Christian, Rubin, Wolohojian, Woody
Lecturers: Chasen, Miller
Instructors: Hollander, Rathbun

The Institute for Urban Studies offers a program leading to a degree in the Master of Arts in Urban Studies. The program is professionally oriented to educate students in the technical competencies involved in urban problem solving and in an interdisciplinary understanding of urban affairs. A graduate of the program would be prepared for a career in governmental, nonprofit or business activities relating to urban affairs. Graduates would also be eligible for pursuing doctoral degrees in the discipline selected for specialized study or in interdisciplinary urban studies and policy analysis programs.

Our 100 graduate students (approximately half of whom are part-time) come from a wide variety of academic backgrounds (e.g., engineering, fine arts, English, history, horticulture, sociology, early childhood education, and political science) and from many walks of life—undergraduate liberal arts degree holders turned career-minded; veterans; returning housewives, and others who have been out of the job market and want a program to provide them re-entry skills and credentials; persons already in urban-related jobs who want to enrich their education and upgrade their credentials. This diverse student body provides a rich learning environment in which many types of experiences and ideas are exchanged.

The Institute provides specializations in urban management, policy analysis and evaluation, community development and urban planning. Specializations may also be developed in any other program offering sufficient graduate or upper division courses. Some of the departments providing such opportunities include: Afro-American Studies, Architecture, Business Administration, Civil Engineering, Computer Science, Criminal Justice and Criminology, Economics, Education, Family and Community Development, Fire Protection Engineering, Geography, Government and Politics, Health, Information Systems Management, Journalism, Recreation, Sociology and Speech and Communications. The student's program of courses in his/her specialization are worked out in consultation with his/her advisor.

Admission and Degree Information

Institute admissions policy is designed to achieve a student mix of experienced practitioners and strong recent graduates. The GRE is generally required of recent graduates whose grade point averages are below 3.2 Applicants with professional experience should provide three letters of recommendation and a vita indicating their education and employment history. Experienced applicants may be admitted provisionally (subject to successful completion of initial coursework) even if their undergraduate grade point average is below regular university requirements, if their employment experience indicates a high probability of success in the program. To accommodate part-time students and students with internships, all required upper division and all graduate courses are offered either 4 to 6:30 or 7 to 9:30 p.m. on a one-day-a-week schedule.

Both a thesis and non-thesis option are available. Each option requires 36 credit hours. Fifteen credit hours, including 6 hours in analytical techniques, must be in core courses and a minimum of 12 hours in an area of specialization. Both options require successful completion of a two-part comprehensive examination. The first part will stress basic urban studies knowledge and analytical skills; the second will be administered by the Institute or the department the student selects for a specialization.

Facilities and Special Resources

In addition to its regular faculty, the Institute regularly draws a number of outstanding adjunct faculty from the Washington Metropolitan Area to teach several courses a year. The adjunct faculty includes: Robert Corleta, Community Development Consultant; David Hartley, Planning Consultant; Jerry Miller, Community Development Consultant; John Murphy, Attorney; Walter Orlinsky, President, Baltimore City Council; John Ross, Director, Division of Economic Development and Public Finance, Department of Housing and Urban Development; Allen Schick, Senior Specialist, Congressional Research Service; Lawrence Shubnell, Consultant in Public Finance; David Walker, Assistant Director, Advisory Commission on Intergovernmental Relations.

Financial Assistance

A limited number of graduate research and teaching assistant positions and fellowships are available and the Institute assists students in

finding internships and part-time jobs in government agencies.

Additional Information

Further information and the graduate bulletin of the Institute for Urban Studies may be obtained from the Director of Graduate Studies of the Institute.

Courses

URBS 420 Seminar in Urban Literature. (3) Prerequisite: Two URBS courses or permission of the instructor. The works of several of the major 20th century writers in urban studies. A comparative analysis of the perspectives of these writers on theoretical and substantive urban issues, is a basis for more advanced study in the theory and process of urbanization.

URBS 430 Urban Internship. (6) Prerequisite: Permission of the department. Supervised field training in urban-oriented programs. Emphasized areas of interest are (1) Neighborhoods and communities, (2) Organizations and agencies, (3) Specific programs. The student will be assigned to a specific agency or project and will be responsible to that agency. Class meetings, written reports, instructor conferences, and a student's critique of his experience are included.

URBS 450 Problems in Urban Law. (3) Recommended preparation: Six credits in URBS courses. A survey of the urban legal environment and special legal problems of urban governments and public interest lawyers. Problems related to planning, zoning, eminent domain and land use controls; consumer protection in central cities; housing codes and multiple dwelling regulation; public accomodations and civil rights ordinances; defending the indigent; and welfare delivery systems.

URBS 480 Urban Theory and Simulation. (3) Review of early theories of the city. Contemporary theories of the city as a physical and an institutional system. Urban theory as integration of information involving economic, political, and social dimensions of contemporary cities. Simulation and gaming as theory testing; urban simulation and gaming as theory building.

URBS 488 Selected Topics in Urban Studies. (3) Prerequisite: Permission of instructor. Topics of special interest to advanced urban studies students. Repeatable to a maximum of six credits provided subject matter is different.

URBS 498 Honors Seminar in Selected Topics. (3) Prerequisite: Admission to Honors Program in URBS or other departments. Individual reading and research, and group discussion dealing with selected major contemporary urban issues: philosophy and growth of new towns; emergent forms of urban policy; federal legislation and the cities; citizen attitudes toward metropolitan government; housing abandonment, rehabilitation, and new construction; the urban future; major world capitals; and urbanization in developing nations. May be repeated to a maximum of six credits for credit provided the topics are different.

URBS 499 Honors Thesis. (3–6) Prerequisite: Admissions to honors program in URBS or other departments. Individual reading and research, and the writing of an original paper on an urban topic of the student's choice under the guidance of a faculty member.

URBS 601 Intermediate Research Methods. (3) Prerequisite: URBS 350 or equivalent. Use of social science research techniques for problem analysis, program evaluation, forecasting and decision-making. Emphasis on the integration of problem and program analysis skills with quantitative techniques. Urban data sources, data collection techniques, experimental and quasi-experimental research design, sampling, modeling, and survey research.

URBS 602 Advanced Research Methods. (3) Prerequisite: URBS 601. Continuation of URBS 601 with emphasis on the integration of alternative quantitative techniques and research strategies. Tests of significance, multiple regression analysis, treatment of time in investment analysis, path analysis, factor analysis, scaling and forecasting techniques.

URBS 630 Urban Economics and Policy Analysis. (3) Prerequisite: ECON 454 or consent of the instructor. Urban problem and policy analysis in the context of urban spatial patterns and trends and urban public sector organization, finance and operation. Education, zoning and land use planning, fiscal diversity and equal opportunity, new communities, the future of the central city, and alternative institutions for the future.

URBS 640 Ecology and Demography of Urban Studies. (3) Analysis of land-use patterns and demographic characteristics. Examination of changes in these relations and their influence on institutional structures. Study of dynamics of transactions and flows between localities. Metropolises as examples of exchange systems. Problems in indicator development which define the demographic and ecological characteristics. Policy implications of data banks based on indicator information. Social indicators for metropolises as predictors of future development.

URBS 660 Urban Social Systems. (3) Prerequisite: URBS 480 or its equivalent or permission of the instructor. A substantive and critical overview of social science approaches to the study of urbanism. Cultural and structural aspects of urban social life.

URBS 666 Urban Management and Decision Making. (3) The processes of urban resource allocation, management, and decision-making. Problems of budgeting for delivery of urban services, citizen participation, role of management and political officials, impact of intergovernmental financial systems such as revenue sharing; administrative centralization and decentralization; metropolitan service districts; and evaluation of urban services provided by cities, counties, and special districts.

URBS 670 Urban Public Policy Analysis. (3) The processes and structures of policy-making and implementation in urban settings. Systematic study of policy outputs through various quantitative indicators of the distribution and delivery of public goods to indicate who decides, on what grounds, who will get how much of what—and why? discussion and application of urban indicators.

URBS 680 Environmental and Land Use Planning. (3) An overview of planning processes needed by the urban administrator and researcher. The elements and techniques of the planning process, and the institutional setting in which planning takes place.

URBS 683 Social Planning and Community Development. (3) Operational aspects of social planning in communities. Models such as those which view social planning as (1) the delivery of social services, (2) a comprehensive approach to community socio-economic and political development, and (3) advocacy of the interests of the disadvantaged. Methods by which the social planner develops the legitimacy and power to catalyze a community to seek and achieve social change.

URBS 688 Recent Developments in Urban Studies. (3) Examination of selected current aspects of the rapidly evolving field of urban affairs, including for example, trends revealed by the 1970 census, evaluation of model cities, "New Towns" in the United States.

URBS 689 Internship Seminar. (3–6) Prerequisite: Permission of the department. A seminar combined with a field internship with an approved urban planning or management office or organization. The internship field supervisor as well as the assignment must be approved by the professor and the director of the institute. A minimum of two days a week must be spent on the field assignment. The seminar will stress the application of urban and administrative theory to the actual urban environment.

URBS 698 Independent Study in Urban Topics. (3) Directed research and study of selected aspects of urban affairs.

URBS 799 Master's Thesis Research. (1–6)

Zoology Program

Professor and Chairman: Corliss
Professors: Anastos, Brinkley, Brown, Clark, Grollman, Haley, Highton, Jachowski, Pierce, Schleidt
Associate Professors: Allan, Barnett, Bonar, Gill, Goode, Higgins, Imberski, Levitan, Linder, Potter, Small, Smith-Gill, Vermeij
Assistant Professors: Buchler, Borgia, Colombini, Inouye, Love, Reaka
Adjunct Professors: Eisenberg, Oppenheim, M. Potter
Adjunct Associate Professors: Heinle, Kleiman, Morton, Sulkin

The Department of Zoology offers programs of study leading to the degrees of Master of Science (thesis and non-thesis) and Doctor of Philosophy with specialization in the following fields: cell biology, developmental biology, estuarine and marine biology, genetics, parasitology, physiology, systematics and evolutionary biology, behavior, invertebrate zoology, endocrinology and ecology.

Admission and Degree Information

Admission to graduate study in the Department of Zoology is restricted to students with an adequate undergraduate preparation in physical as well as biological sciences, including upper division courses in zoology and courses in mathematics (through one year of calculus), statistics, physics, and chemistry through organic. Able students who lack preparation in a particular area may be admitted, provided that the deficiency is corrected early in the graduate work. Graduate Record Examinations are recommended but are not required.

The thesis master's program enables a student to engage in advance study and to undertake a research project. It may be a terminal degree or may demonstrate the student's research ability and lead to continuation of graduate work for the Ph.D. in the same or related area. There are no requirements in excess of the general requirements established by the Graduate School. All requirements for the master's degree are to be completed within a three year period. A final oral examination on the thesis is given whenever the student has completed all other requirements for the degree.

The non-thesis master's program provides opportunity for advanced education and a terminal degree for those who are not research-oriented. All non-thesis master's students are required to complete no fewer than 30 hours of course work, of which no fewer than 18 must be at the 600 level or above in Zoology or appropriate related fields. No fewer than 16 hours of courses must be in Zoology and three of these courses should be in a single area of specialization. In addition, it is expected that at least one satisfactory scholarly paper be written in an area approved by the student's advisor and that a written comprehensive examination in three areas of Zoology be passed. All requirements must be completed within a three-year period.

The Ph.D. program in Zoology is basically a research program providing maximal opportunity for the student to evolve and develop his innate capacity for scholarship and independent work. A doctoral candidate must register for a minimum of 12 semester hours of doctoral research (899). Opportunity is provided for in-depth study in an area of specialization. A formal preliminary examination is given to all doctoral students within the first two years of enrollment in the Department. The examination is basically an oral examination focusing primarily on determination of whether or not the student has the proper motivation, intellectual capacity and curiosity, and educational background and has or can develop the technical skills to successfully pursue the Ph.D. program. However, there is no formal restriction on the extent or the range of the questions asked of the candidate. The doctoral dissertation must be completed and defended usually within three, preferably two years, after passing of prelims.

Facilities and Special Resources

The Zoology Department's share of the Zoo-Psyc Building provides adequate space for graduate teaching and research. The research laboratories are well equipped, and major pieces of experimental apparatus are available which have imparted a tremendous research capability to the Department. These include radiation counting devices, ultra centrifuges, high speed refrigerated centrifuges, spectrophotometers, amino acid analyzers, spectrofluorometers, mechanical and electrical recording devices, fraction collectors, ultra microbalances, and autoclaves. In addition, the Department has special suites for electronmicroscopic and scanning electronmicroscopic work, constant temperature rooms, four sound proof rooms—one being an anechoic chamber designed specifically for sophisticated research in ethology—photographic dark rooms, sterile transfer rooms, and a histotechnology suite.

Although the Department maintains no library of its own, the University has a fine graduate library housing a Science and Technology Division. In addition, facilities such as the National Library of Medicine and the Department of Agriculture Library as well as the Library of Congress greatly expand the Library material within relatively easy access to the Department.

Additional Information

Students are urged to communicate directly with the faculty in the area of their interest but additional general information and a statement of particular departmental requirements may be obtained by writing to the Director of Graduate Studies, Department of Zoology.

Courses

ZOOL 411 Cell Biology. (4) Two hours of lecture, one hour of demonstration-discussion and three hours of laboratory per week. Prerequisites: Two years of zoology and organic chemistry, or permission of the instructor. A study of cell structure and function with an emphasis on the activity of subcellular organoids and the mechanisms of coordination and control of cell function.

ZOOL 413 Biophysics. (3) Three lectures a week. Prerequisites: One year of biology, a year of Physics and at least one semester of Calculus; or permission of the instructor. An introduction to the ideas and methods used in biophysics to analyze the functional components of cells and tissues as physical-chemical systems.

ZOOL 415 Cell Differentiation. (3) Three hours of lecture per week. Prerequisites: A course in development biology, cell biology, molecular genetics or permission of instructor. Cellular and subcellular differentiation, emphasizing the biochemical and ultrastructural bases of these development changes.

ZOOL 421 Neurophysiology. (4) Three hours of lecture and three hours of laboratory per week. Prerequisites: An introductory course in zoology or biology; a semester of organic chemistry; physics, through an introduction to electricity and magnetism; MATH 110 or 115. The physiology of nerves, muscles and sensory receptors and aspects of central nervous system physiology.

ZOOL 422 Vertebrate Physiology. (4) Three hours of lecture and three hours of laboratory per week. Prerequisites: One year of zoology and one semester of organic chemistry. A study of the cardiovascular, hemopoietic, gastrointestinal, renal and respiratory systems. Chemical and endocrine regulation of physiological functions in higher vertebrates with emphasis on mammals.

ZOOL 426 General Endocrinology. (3) Three hours of lecture per week. Prerequisites: Three semesters of animal biology and two semesters of organic chemistry. Functions and the functioning of the endocrine glands of animals with special reference to the vertebrates.

ZOOL 430 Vertebrate Embryology. (4) Two hours of lecture and six hours of laboratory per week. Prerequisites: A course in genetics; either ZOOL 290 or 422; or permission of instructor. Vertebrate embryogenesis, developmental physiology and experimental embryology.

ZOOL 431 Advanced Developmental Biology (3) Three hours of lecture/discussion per week. Prerequisites: a course in developmental biology or embryology, a course in Genetics or Cell Biology, or permission of instructor. An in-depth study of the progression of selected problems in developmental Biology from their origins in classical experimental embryology to modern molecular developmental biology, through analysis of original articles and experimental results.

ZOOL 440 Evolution. (3) Three hours of lecture per week. Prerequisites: A course in genetics and a course in animal diversity. A consideration of current thought in regard to the evolution of living organisms.

ZOOL 444 Advanced Evolutionary Biology. (3) Three hours of lecture per week. Prerequisites: ZOOL 440 or equivalent; one semester of calculus. The nature and consequences of organic evolution in relation to present day geography and geologic time. Topics covered will include organic diversity gradients in space and time, rates of evolution, co-evolution and extinctions. Particular emphasis will be placed in the synthesis of information and on construction and evaluation of hypotheses.

ZOOL 445 genetic Analysis. (3) Prerequisites: CHEM 104 and introductory courses in Genetics and statistics. A consideration of the mechanisms involved in the transmission of hereditary factors in eukaryotes. Emphasis on the experimental evidence and its interpretation which underlies our present knowledge of heredity.

ZOOL 446 Molecular Genetics. (3) Three hours of lecture per week. Prerequisites: ZOOL 246 or equivalent and a course in organic chemistry. The molecular basis of gene structure and function. Regulation of differential gene expression.

ZOOL 447 Experimental Genetics. (4) Two hours of lecture and six hours of laboratory per week. Prerequisites: Two courses in genetics, one of which included laboratory work, and permission of instructor. A methodology and techniques course considering experimental design, the use of diverse organisms and instrumentation and the presentation and interpretation of data.

ZOOL 460 Ethology. (3) Prerequisites: ZOOL 293 and one course in physiology, vertebrate morphology, or ecology. An introduction to the principles of animal behavior with emphasis on physiological bases, ecological correlates and evolutionary aspects of behavior.

ZOOL 461 Ethology Laboratory. (3) One hour of lecture and six hours of laboratory per week. Prerequisite or corequisite: ZOOL 460 or equivalent. Training in the description of behavior, methods of quantification and experimentation, and the mathematical treatment of behavioral data.

ZOOL 470 Advanced Animal Ecology. (2) Two hours of lecture per week. Prerequisites: One year of zoology, a course in calculus and a course in statistics. A course in genetics is strongly recommended. Designed for majors and graduate students in the biological sciences. Topics to include theory of population growth and regulation, life tables and population projection matrices, niche theory, theory of competition and predation, diversity analysis, and energetic modeling. Emphasis will be on current literature and research in ecological theory.

ZOOL 471 Laboratory and Field Ecology. (2) Three hours of laboratory and field work and one hour of discussion per week. Prerequisites: ZOOL 470 previously or concurrently. Exercises in laboratory and field will pursue problems of contemporary ecological interest; population density regulation, community structure, niche shape, competition coefficients, pattern diversity, and energetics of ecosystems. Topics will be coordinated with those presented in ZOOL 470. Terrestrial and aquatic systems will be studied.

ZOOL 472 Protozoology. (4) Two hours of lecture and six hours of laboratory including field trips per week. Prerequisite: One year of biology. Basic conceptual treatment of free-living and parasitic protozoan functional morphology, life history, and systematics. The laboratory will stress observations of protozoa, living ans stained, collected from diverse habits.

ZOOL 473 Marine Ecology. (3) Prerequisites: A course in invertebrate zoology or animal diversity, and ZOOL 470, or permission of the instructor. Courses in evolution and animal behavior are strongly recommended. A detailed analysis of the evolutionary ecology of marine invertebrates; emphasis on testing of theories and on current literature.

ZOOL 475 General Parasitology. (4) Two hours of lecture and six hours of laboratory per week. Prerequisites: Two years of ZOOL and one year of chemistry, or permission of the instructor. A consideration of the phenomenon of parasisism through a study of the structure, function and host relationships of parasitic organisms.

ZOOL 477 Symbiology. (3) Prerequisite: ZOOL 293. An introduction to basic concepts of symbiosis. Adaptations for establishment of sybiotic associations, symbiote nutrition and metabolism, responses of the host and ecology of the host-symbiote complex.

ZOOL 480 Aquatic Biology. (4) Two hours of lecture and six hours of laboratory per week. Prerequisite: A course in animal diversity and a course in ecology. An investigation of the causal relationships of freshwater, estuarine and marine biotic communities to their environment.

ZOOL 481 The Biology of Marine and Estuarine Invertebrates. (4) Two hours of lecture and six hours of laboratory per week. Prerequisite: One year of zoology. An in-depth consideration of the taxonomy and functional morphology of the invertebrates, exclusive of insects. Chesepeake Bay forms and the study of living material will be emphasized.

ZOOL 482 Marine Vertebrate Zoology. (4) Two hours of lecture and six hours of laboratory per week. Prerequisite: Two years of zoology or permission of the instructor. A consideration of the evolution, taxonomy, morphology, physiology, behavior and ecology of marine and estuarine protochordates and vertebrates.

ZOOL 483 Vertebrate Zoology. (4) Two hours of lecture and four hours of laboratory per week. Prerequisite: One year of zoology or permission of the instructor. The identification, classification, habits, and behavior of vertebrates with emphasis on fresh water, terrestrial and aerial forms, and a consideration of the evolution of living and fossil representatives.

ZOOL 492 Form and Pattern in Organisms. (3) Prerequisites: One year of calculus; one year of physics; one semester of Introductory biology. A lecture course in structural and functional interpretation of form in organisms. Pattern formation in morphogenesis, mathematical description of shape, methods, and examples of functional analysis of form, and patterns of morphological diversity through space and time.

ZOOL 495 Mammalian Histology. (4) Two hours of lecture and six hours of laboratory per week. Prerequisites: A course in vertebrate anatomy and a course in vertebrate physiology or permission of the instructor. A study of the microscopic anatomy, ultrastructure and histophysiology of tissues and organs of mammals.

ZOOL 608 Zoology Seminar. (1–6) Repeatable to a maximum of six credits. One seminar a week for each subject selected: A—Cell Biology, B—Developmental Biology, C—Estuarine + Marine Biology, D—Genetics, E—Parasitology, F—Physiology, G—Systematic + Evolutionary Biology, I—Behavior, J—Recent Advances, K—Endocrinology, L—Ecology.

ZOOL 609 Special Problems in Zoology. (1–6) Repeatable to a maximum of six credits. One seminar a week for each subject selected: A—Cell Biology, B—Developmental Biology, C—Estuarine + Marine Biology, D—Genetics, E—Parasitology, F—Physiology, G—Systematic + Evolutionary Biology, I—Behavior, J—Recent Advances, K—Endocrinology, L—Ecology.

ZOOL 610 Cellular Physiology. (4) Two lectures and two three-hour laboratory periods a week. Prerequisites: A course in animal or plant physiology, one year of organic chemistry, one year of physics, and a course in biochemistry. Reccommended: ZOOL 411 or an equivalent course in cytology or cell biology. A study of the structure and functions of cells on the molecular, subcellular and cellular levels by investigations and discussions of their physical, chemical, and microscopic properties.

ZOOL 612 Electron Microscopy Laboratory I. (3) Two three-hour laboratories per week and additional arranged time. Prerequisite: A lecture course in electron microscopy and permission of instructor. Prepara-

tion and study of biological material by electron microscopy

ZOOL 613 Electron Microscopy Laboratory II. (2) Two three-hour laboratories per week. Prerequisite: ZOOL 612 or equivalent and permission of instructor. A directed individual research project that uses the techniques of electron microscopy to study biological materials.

ZOOL 615 Biological Ultrastructure. (3) Three hours of lecture-discussion a week. Prerequisite: cell biology or histology, or permission of instructor. The ultrastructure of cells and tissues, with emphasis on interpretation and correlation of ultrastructure and function.

ZOOL 616 Advanced Topics in Cell Biology. (3) Three lecture-discussion periods a week. Prerequisites: One year of biochemistry, one year of physics, a course in cell biology or physiology, or permission of the instructor. An inquiry into the physico-chemical background and current advances in selected aspects of cell structure and function.

ZOOL 621 Comparative Physiology. (4) Three lectures and one three-hour laboratory period each week. Prerequisite: One year of zoology, one year of organic chemistry and one semester of physiology. The study of the differences and similarities in the functioning of organs of species of the animal kingdom.

ZOOL 624 Experimental Mammalian Physiology. (4) Two four-hour laboratory periods a week. Prerequisites: A course in physiology and one year of chemistry above general chemistry. The theory, use and application to research of instrumentation normally in the physiology laboratory with an introduction to surgical techniques on both large and small animals.

ZOOL 625 Comparative Invertebrate Endocrinology. (3) Three lectures a week. Prerequisites: One year of organic chemistry, a course in endocrinology and a course in physiology, or permission of instructor. A systematic approach to the structure and physiology of neuro-endocrine systems of invertebrates.

ZOOL 626 Mammalian Physiology. (3) One three-hour lecture a week. Prerequisite: A course in physiology and a course in biochemistry. A biochemical and pharmacological approach to problems in physiology. A survey of neurochemistry and Neuropharmacology, the study of action of hormones and drugs at the molecular and cellular level.

ZOOL 627 Comparative Vertebrate Endocrinology. (3) Three lectures each week. Prerequisite: One semester of biochemistry, physiology and endocrinology. Study of the difference and similarities in the structure and functioning of the endocrine organs of the vertebrate species.

ZOOL 628 Electrophysiology (4) Two lectures and two three-hour laboratory periods a week. Prerequisites: A course in physiology, one year of physics, and permission of the instructor. Concerned with electrical phenomena occurring in living matter and with the effect of electrical current on cells, with special emphasis on nerves and muscles.

ZOOL 630 Organogenesis. (2) Two lectures per week. Prerequisite: A course in Embryology or development biology. The experimental basis of developmental mechanisms.

ZOOL 631 Biochemical Patterns in Development (3) Prerequisites: ZOOL 630 and a course in biochemistry. The biochemical and cellular mechanisms regulating gene activity and cell differentiation, emphasizing early development of higher eukaryotic organisms.

ZOOL 632 Animal Morphogenesis (3) Prerequisites: ZOOL 630. The processes and mechanisms of tissue interactions, and their developmental consequences for the cell, tissue, and organism.

ZOOL 634 Experimental Developmental Zoology. (4) Prerequisite: Permission of instructor. Two four-hour lecture/lab periods per week. A laboratory-oriented course focused on current problems in Developmental Zoology and designed to instruct students modern experimental techniques.

ZOOL 640 Population Genetics. (4) Two lectures and two three-hour laboratory periods a week. Prerequisite: A course in genetics. The role of mutation, selection, migration, inbreeding, and stochastic process in evolution.

ZOOL 641 Ecological Genetics. (3) Three hours of lecture-discussion a week. Prerequisites: A course in genetics and a course in ecology, or permission of the instructor. Analysis of the interactions between genotype and the environment in natural and experimental populations of animals

ZOOL 642 Developmental Genetics. (3) Three lecture-discussion periods per week. Prerequisites: Courses in molecular genetics and developmental or cell biology, or permission of the instructor. Differential gene function and its regulation in developing systems. Genes and the analysis of developmental processes.

ZOOL 643 Cellular Genetics. (3) Two 1½ hour lecture-discussion periods a week. Prerequisites: 1 year of genetics including basic molecular genetics or permission of the instructor. The course will evaluate studies using protozoan systems as models for analyzing phenomena of nuclear differentiation, cytoplasmic heredity and control of cellular organization.

ZOOL 650 Systematic Zoology. (4) Three lectures and one three-hour laboratory period a week. The principles and methods involved in the classification of animals, with emphasis on population dynamics and speciation. Methods of evaluating taxonomic data, principles of zoological nomenclature, field and museum techniques, and the factors influencing the distribution of animals are also stressed.

ZOOL 660 Advanced Ethology Laboratory (4) Two lectures and two three-hour laboratory periods a week. Prerequisites: ZOOL 460 and ZOOL 461, or equivalent, and permission of the instructor. Group project in behavioral research on a topic to be decided by the participants. Practical research experience to the new graduate student in ethology, from the writing of a research proposal through observation and experimentation to the final report.

ZOOL 661 Principles and Methods in Ethology (4) Two lectures and two three-hour laboratory periods per week. Prerequisites ZOOL 460, 461 and permission of the instructor. The physics and physiology of signal production and reception with emphasis on animal communication systems.

ZOOL 665 Sociobiology. (4) Two lectures and two three-hour laboratory periods a week. Prerequisites: A course in behavior and permission of the instructor. Deals with the description and analysis of animal social organizations, the adaptive nature of animal societies, the effects of early experience, and the role of communication in the integration of animal groups.

ZOOL 670 Analysis of Animal Populations. (4) Two lectures and two three-hour laboratory periods a week. Prerequisite: A course in ecology or permission of instructor. An advanced course in animal ecology with a focus on populations. Studies of growth and regulation of animal populations are emphasized.

ZOOL 671 Quantitative Zoology. (4) Three lectures and one three-hour laboratory period a week. Prerequisites: MATH 140 or equivalent and permission of instructor. A consideration of the statistical techniques of principal importance in the analysis of biological data.

ZOOL 673 Advanced Aquatic Ecology. (4) Prerequisite: ZOOL 670 or equivalent. One discussion session (arranged) and one all-day laboratory per week. Emphasizes field experience in analyzing ecological processes in freshwater lakes and rivers, and the plankton communities of estuaries.

ZOOL 674 Quantitative Field Ecology. (4) One full day per week. Prerequisites: animal or plant ecology, statistics, and permission of instructor. Group-oriented formulation of hypotheses, collection of data, analysis and discussion of results. Current problems in community and population ecology to be studied in the field. Extended field trips.

ZOOL 675 Ecological Models. (3) Three hours of lecture-discussion a week. Prerequisite: ZOOL 670 or equivalent. Explores the assumptions, structure and consequences of theoretical models in ecology.

ZOOL 676 Behavioral Ecology. (4) Prerequisites: A course in ecology and a course in behavior, or permission of the instructor. Two lecture-recitation periods and six hours of laboratory per week. The role of interactions among organism and environment upon the dynamics and resource utilization of animals.

ZOOL 677 Ecology of Marine Communities. (4) Prerequisites: ZOOL 670 or permission of the instructor, ZOOL 481 strongly recommended. Two lecture-recitation periods and six hours of laboratory per week. An evaluation and extension of our current knowledge of marine communities and how their component populations are limited and interact with one another

ZOOL 681 Physiological Ecology. (4) Two lectures and two three-hour laboratory periods a week. Prerequisites: A course in invertebrate zoology, physiology and in ecology An in-depth comparative study of the physiological interactions of marine and estuarine invertebrates and their environment.

ZOOL 682 Ecology of Marine Invertebrates. (4) Two lectures and six hours of laboratory a week (including some Saturday field trips). Prerequisites. A course in animal ecology, or hydrobiology, and invertebrate zoology, or permission of instructor. The distribution, abundance, and adaptations of marine and estuarine invertebrates as related to the factors of those environments.

ZOOL 686 Marine and Estuarine Protozoa. (4) Two lectures and six hours of laboratory per week. An in-depth study of the taxonomic and morphological diversities, life histories, and autecologies of the protozoan fauna of marine and estuarine environments. Special emphasis will be placed on Chesapeake Bay forms. Field work will be an integral part of the laboratory, and shipboard experience is anticipated. Permission of instructor required. Offered in alternate years.

ZOOL 708 Lectures in Zoology. (1–3) One, two or three lectures a week. Advanced lectures by outstanding authorities in their particular field of zoology. As the subject matter is continually changing, a student may register several times, receiving credit for several semesters.

ZOOL 709 Lectures in Zoology. (1–3) One, two or three lectures a week. Advanced lectures by outstanding authorities in their particular field of zoology. As the subject matter is continually changing, a student may register several times, receiving credit for several semesters.

ZOOL 770 Experimental Parasitology. (4) Two lectures and two three-hour laboratory periods a week. Prerequisites: A course in parasitology and permission of the instructor. Experiments performed utilizing living parasites in laboratory animals to illustrate various aspects of the host-parasite relationship.

ZOOL 771 Helminthology. (4) Two lectures and two three-hour laboratory periods a week. Prerequisites: Two years of zoology and permission of the instructor. A study of the classification, structure and biology of the Helminths.

ZOOL 778 Advanced Topics in Protozoology. (4) The advanced study and analysis of selected protozoological topics; e.g.; advanced cytology and techniques, morphogenesis, and systematics and evolution. Two lectures and six hours of laboratory per week, emphasizing the research literature. Prerequisite: A course in general protozoology or permission of instructor. Offered in alternate years. May be taken more than once since topic coverage will change. May be repeated to a maximum of twelve semester hours.

ZOOL 799 Master's Thesis Research. (1–6)

ZOOL 878 Advanced Topics in Parasitology. (1–16) Prerequisites: Advanced graduate standing and permission of the instructor. The content of the course changes frequently and students may register for it several times. The course will consist of critical discussions of the published literature and current problems in parasitology: 1. Host-parasite relationships; 2. ecology of parasites; 3. immunity to parasites; and 4 physiology of parasites.

ZOOL 899 Doctoral Dissertation Research. (1–8)

Additional Graduate Level Course Offerings

AFRO-AMERICAN STUDIES COURSES

AASP 400 Directed Readings in Afro-American Studies. (3) The readings will be directed by the director of Afro-American studies. Topics to be covered: the topics will be chosen by the director to meet the needs and interests of individual students.

AASP 401 Seminar in Afro-American Studies. (3) The theory and concepts of the social and behavioral sciences as they relate to Afro-American Studies. Required for the certificate in Afro-American Studies. Prerequisites: At least 15 hours of Afro-American Studies or related courses or permission of the director.

AASP 403 The Development of a Black Aesthetic. (3) An analysis of selected areas of black creative expression in the arts for the purpose of understanding the informing principles of style, techniques, and cultural expression which make up a black aesthetic. Prerequisite: Completion of ENGL 443 or AASP 302 or consent of instructor.

AASP 410 Contemporary African Ideologies. (3) Analysis of contemporary African ideologies. Emphasis on philosophies of Nyerere, Nkrumah, Senghor, Sekou Toure, Kaunda, Cabral, et al. Discussion of the role of African ideologies on modernization and social change.

AASP 411 Black Resistance Movements. (3) A comparative study of the black resistance movements in Africa and America; analysis of their interrelationships as well as their impact on contemporary pan-Africanism.

AASP 428 Special Topics in Black Development. (3) A multi-disciplinary and inter-disciplinary educational experience concerned with questions relevant to the development of black people everywhere. Development implies political, economic, social, and cultural change among other things. Consequently, a number of topics may be examined and studied.

AASP 429 Special Topics in Black Culture. (3) An interdisciplinary approach to the role of black artists around the world. Emphasis is placed upon contributions of the black man in Africa, the Caribbean and the United States to the literary arts, the musical arts, the performing arts, and the visual arts. Course content will be established in terms of those ideas and concepts which reflect the cultural climate of the era in which they were produced. Attention to individual compositions and works of art through lectures, concepts, field trips, and audio-visual devices.

AGRICULTURE COURSES

AGRI 489 Special Topics in Agriculture. (1–3) Credit according to time scheduled and organization of the course. A lecture series organized to study in depth a selected phase of agriculture not normally associated with one of the existing programs.

AGRI 702 Experimental Procedures in the Agricultural Sciences. (3) First semester. Prerequisite: Permission of instructor. Organization of research projects and presentation of experimental results in the field of Agricultural Science. Topics included will be: sources of research financing, project outline preparation, formal progress reports, public and industrial supported research programs, and popular presentation of research data.

ANTHROPOLOGY COURSES

ANTH 401 Cultural Anthropology—Principles and Processes. (3) Prerequisite: ANTH 101, 102, or 221. An examination of the nature of human culture and its processes, both historical and functional. The approach will be topical and theoretical rather than descriptive.

ANTH 402 Cultural Anthropology—World Ethnography. (3) Prerequisite: ANTH 101, 102, or 221. A descriptive survey of the culture areas of the world through an examination of the ways of selected representative societies.

ANTH 412 Peoples and Cultures of Oceania. (3) A survey of the cultures of Polynesia, Micronesia, Melanesia and Australia. Theoretical and cultural-historical problems will be emphasized.

ANTH 414 Ethnology of Africa. (3) Prerequisites: ANTH 101 and 102. The native peoples and cultures of Africa and their historical relationships, with emphasis on that portion of the continent south of the Sahara.

ANTH 417 Peoples and Cultures of the Far East. (3) A survey of the major sociopolitical systems of China, Korea and Japan. Major anthropological questions will be dealt with in presenting this material.

ANTH 423 Ethnology of the Southwest. (3) Prerequisites: ANTH 101 and 102. Culture history, economic and social institutions, religion, and mythology of the Indians of the Southwest United States.

ANTH 424 Ethnology of North America. (3) Prerequisites: ANTH 101 and 102. The native people and cultures of North America north of Mexico and their historical relationships, including the effects of contact with European-derived populations.

ANTH 426 Ethnology of Middle America. (3) Prerequisites: ANTH 101 and 102. Cultural background and modern social, economic and religious life of Indian and Mesitzo groups in Mexico and Central America; processes of acculturation and currents in cultural development.

ANTH 431 Social Organization of Primitive Peoples. (3) Prerequisites: ANTH 101 and 102. A comparative survey of the structures of non-literate and folk societies, covering both general principles and special regional developments.

ANTH 434 Religion of Primitive Peoples. (3) Prerequisites: ANTH 101 and 102. A survey of the religious systems of primitive and folk societies, with emphasis on the relation of religion to other aspects of culture.

ANTH 436 Primitive Technology and Economy. (3) A survey of technology, food economy and general economic processes in non-industrial societies.

ANTH 437 Politics and Government in Primitive Society. (3) A combined survey of politics in human societies and of important anthropological theories concerning this aspect of society.

ANTH 441 Archaeology of the Old World. (3) Prerequisite: ANTH 101 or 241. A survey of the archaeological materials of Europe, Asia and Africa, with emphasis on chronological and regional interrelationships.

ANTH 451 Archaeology of the New World. (3) Prerequisite: ANTH 101 or 241. A survey of the archaeological materials of North and South America with emphasis on chronological and regional interrelationships.

ANTH 461 Human Osteology Laboratory. (3) Prerequisite: ANTH 101. A laboratory study of the human skeleton, its morphology, measurement, and anatomic relationships.

ANTH 462 Primate Anatomy Laboratory. (3) Prerequisite: ANTH 101. The gross anatomy of non-human primates. Laboratory dissection of various primate cadavers under supervision. Occasional lectures.

ANTH 463 Primate Studies. (3) Prerequisite: ANTH 101. A combination lecture and laboratory examination of non-human primates. Major studies of various types that have been undertaken in the laboratory and in the field.

ANTH 465 Human Growth and Constitution. (3) Prerequisite: ANTH 101. A laboratory study of the growth, development and age changes in the human body from conception through old age, including gross photographic, radiographic, and microscopic study of growth and variation.

ANTH 466 Forensic Anthropology Laboratory. (3) Prerequisite: ANTH 461 or permission of the instructor. A laboratory study of the methods used to identify human remains by anthropological techniques and discussion of the role of the anthropologist in medicolegal investigation.

ANTH 467 Human Population Biology Laboratory. (3) Prerequisite: ANTH 101. A laboratory study of human population genetics, dynamics and variation, including anthropological seriology, biochemistry, dermatoglyphics and hair microscopy.

ANTH 498 Field Methods in Ethnology. (1–6) Field training in the collection and recording of ethnological data.

ANTH 499 Field Methods in Archaeology. (1–6) Field training in the techniques of archaeological survey and excavation.

ANTH 605 Theory of Cultural Anthropology. (3) History and current trends of cultural anthropological theory, as a basic orientation for graduate studies and research.

ANTH 621 Cultural Ecology. (3) Prerequisite: Permission of instructor. An examination of the nature of the interrelationships between human cultures and the natural environmentals in which they exist.

ANTH 631 Evolution in Social Institutions. (3) An inquiry into the origin and development of institutions of kinship, marriage, and group formation in differing socio-cultural systems.

ANTH 637 Political Power and Organization. (3) A seminar concerning the nature of political power, distribution, and the way it allows different socio-cultural systems to solve major adaptive problems.

ANTH 641 Method and Theory in Archaeology. (3) Prerequisite: Permission of the instructor. An examination of the principles and purposes involved in the gathering and interpretation of archaeological data.

ANTH 661 Human Morphology. (3) Prerequisite: ANTH 461 or its equivalent and permission of the instructor. The nature and variation of human skeletal and somatic characters, with emphasis on evolutionary developments.

ANTH 681 Processes of Culture Change. (3) Change in culture due to contact, diffusion, innovation, fusion, integration, and cultural evolution.

ANTH 685 Peasant Communities in the Modern World. (3) Comparative analysis of peasant communities in Latin America, Europe, Middle East, Asia and Africa.

ANTH 688 Current Developments in Anthropology. (3) Detailed investigation of a current problem or research technique, the topic to be chosen in accordance with faculty interests and student needs. May be repeated, as content varies, for a total of not more than nine semester hours.

ANTH 689 Special Problems in Anthropology. (1–6)

ANTH 698 Advanced Field Training in Ethnology. (1–6) Offered in the summer session only.

ANTH 699 Advanced Field Training in Archaeology. (1–6) Offered in the summer session only.

APPLIED DESIGN COURSES

APDS 430 Advanced Problems in Advertising Design. (3) Two studio periods. Prerequisite: APDS 331. Advanced problems in design and layout planned for developing competency in one or more areas of advertising design.

APDS 431 Advanced Problems in Advertising Design. (3) Two studio periods. Prerequisite: APDS 430. Advanced problems in design and layout planned for developing competency in one or more areas of advertising design.

APDS 437 Advanced Photography. (3) Three studio periods. Continuation of APDS 337.

APDS 499 Individual Problems in Applied Design. (3–4) A—Advertising, B—Costume. Open only to advanced students who, with guidance can work independently. Written consent of instructor.

BIOMETRICS COURSES

BIOM 401 Biostatistics I (4) Three lectures and one discussion per week. Prerequisite: MATH 115, BIOM 301, or permission of the instructor. Descriptive statistics, probability models useful in Biology, expectations, hypothesis testing, sign test, goodness of fit tests, central limit theorem, point and interval estimates, analysis of variance, regression, correlation, sampling, rank tests. Emphasis on the uses and the limitations of these methods in Biology.

BIOM 420 Sampling Techniques in Biometrics (3) Prerequisite: BIOM 401 or permission of the instructor. Methods of sampling: probability, random, cluster, stratified, inverse; ratio estimates; methods in field surveys: mark recapture studies, line transect sampling; surveys, design of collection forms; sample size calculations. Emphasis on the use of these methods in biological research.

BIOM 602 Biostatistics II (3) Prerequisite: BIOM 401 or equivalent. A study of statistical techniques commonly used in Biology, with emphasis on application, interpretation and presentation of the results. The analysis of hierarchial, two-way and multiway classifications, split-plot designs, factorial experiments, multiple regression and analysis of co-variance.

BIOM 605 Computer Applications in Biostatistics (1) One, 2 hour laboratory per week. Pre- or corequisite: BIOM 602 or consent of instructor. Introduction to computer usage for simple data transformation and manipulation; preparation of data for statistical analysis; handling and storage of data; utilization of computer terminals; preparation of tables and graphs. Use of statistical packages for analysis of biological data, with problems scheduled to parallel lecture topics in BIOM 602.

BIOM 606 Design of Experiments (3) Two lectures and one discussion per week. Prerequisites: BIOM 602 or equivalent. A study of the principles of experimental design and the application of basic and advanced designs. The completely random, randomized complete block, latin square, and split-plot designs; factorial experiments, confounding, fractional replication, incomplete designs and methods for studying response surfaces. Evaluation of research proposals with respect to statistical validity and the efficiency of the proposed design and analysis.

BIOM 688 Topics in Biometrics (1–3) Prerequisite: Consent of the instructor. Advanced topics of current interest in various areas of Biometrics. Credit assigned will depend on lecture and/or laboratory time scheduled and organization of the course.

BIOM 698 Special Problems in Biometrics (1–3) Prerequisite: Consent of instructor. Individual study of a particular topic in Biostatistics or Biomathematics.

BIOM 699 Seminar in Biometrics (1)

CHINESE COURSES

CHIN 401 Readings in Chinese History and Literature I. (3) Prerequisite: CHIN 302 or equivalent. A language training course using original sources in history and literature.

CHIN 402 Readings in Chinese History and Literature II. (3) Prerequisite: CHIN 401 or equivalent. A language course training using original sources in history and literature.

CHIN 403 Classical Chinese I. (3) Prerequisite: CHIN 302. Introductory Classical Chinese using literary and historical sources in the original language.

CHIN 404 Classical Chinese II. (3) Prerequisite: CHIN 302. Further classical studies by various writers from famous ancient philosophers to prominent scholars before the new culture movement.

CHIN 405 Advanced Conversation and Composition I. (3) Prerequisite: CHIN 202 or equivalent. Review of contemporary grammar with emphasis on contemporary materials and free composition.

CHIN 406 Advanced Conversation and Composition II. (3) Prerequisite: CHIN 405 or equivalent. Analysis of the role of language in literature; study of principles and techniques of advanced composition, speech composition, letter and report writing.

CHIN 411 Chinese Civilization. (3) This course supplements GEOG 422; cultural geography of China and Japan. It deals with Chinese literature, art, folklore, history, government, and great men. The course is given in English.

CHIN 412 Chinese Civilization. (3) Developments in China since 1911. The course is given in English.

CHIN 415 Readings in Current Newspapers and Periodicals I. (3) Prerequisite: CHIN 302 or equivalent. Translation of original sources in politics and economics with special emphasis on reading Chinese communist documents written in simplified Chinese characters. Readings in Chinese; instruction in English.

CHIN 416 Readings in Current Newspapers and Periodicals II. (3) Prerequisite: CHIN 415 or equivalent. Continuation of CHIN 415.

CHIN 421 Chinese Linguistics. (3) Prerequisite: CHIN 102 or equivalent.

CHIN 422 Chinese Linguistics. (3) Prerequisite: CHIN 102 or equivalent.

CHIN 431 Translation and Interpretation I. (3) Prerequisite: CHIN 202 or equivalent. Introduction to the history and theories of translation/interpretation; contrastive studies of the structures of English and Chinese; development of the four language skills.

CHIN 432 Translation and Interpretation II. (3) Prerequisite: CHIN 431 or equivalent.

CHIN 441 Traditional Chinese Fiction in Translation. (3) Prerequisite: CHIN 313 or 314, or permission of instructor. Readings from the 4th century tale of the marvelous through the 18th century Ching novel, including major works of fiction, literary history and criticism.

CHIN 442 Modern Chinese Fiction in Translation. (3) Prerequisite: CHIN 313 or 314, or permission of instructor. Readings from the literary Revolution of 1917 to the present, including major works of fiction, literary history, and criticism.

CHIN 499 Directed Study in Chinese. (1–3) Prerequisite: Permission of instructor. Readings in Chinese under faculty supervision. If content differs, repeatable to a maximum of six credits.

CLASSICS COURSES

CLAS 470 Advanced Greek and Roman Mythology (3) Prerequisites: CLAS 170 or permission of instructor. Selected themes and characters of Greek and Roman myth. History of the study of myth and research methods in mythology.

CRAFTS COURSES

CRAF 420 Advanced Ceramics II. (3) Three studio periods. Prerequisite: CRAF 330. Experience in experimental development of body and textures, glazes and colors and their utilization in clay products of original design. Calculation of body and glaze composition.

CRAF 428 Individual Problems in Ceramics. (3) Prerequisites: CRAF 200, 320, 420. Open to students with demonstrated ability and with the potential for a high level of achievement in studio production or in research. Total undergraduate credit permitted in all individual problems courses in crafts is a maximum of nine hours. Consent of Crafts faculty. No less than B average on prerequisites and presentation of work for evaluation.

CRAF 430 Advanced Metalry II. (3) Two studio periods. Prerequisite: CRAF 330. Advanced application of skills to the design and fabrication of metals; jewelry, stone setting, metal casting, cloisonne. Hand-raised hollow.

CRAF 438 Individual Problems in Metalry. (3) Prerequisites: CRAF 230, 330, 430 with at least a grade of B in all three courses. Open to students with demonstrated ability and with the potential for a high level of achievement in studio production or in research. Total undergraduate credit permitted in all individual problems courses in Crafts is a maximum of nine hours. Consent of Crafts faculty. No less than B average on prerequisites and presentation of work for evaluation.

CRAF 448 Individual Problems in Textile Design. (3) Prerequisites: CRAF 240, 241, 340, or 341 with at least a grade of B in all three courses. Open to students with demonstrated ability and with the potential for a high level of achievement on studio production or in research. Total undergraduate credit permitted in all individual problems courses in crafts as a maximum of nine hours. Consent of Crafts faculty. No less than B average on prerequisites and presentation of work evaluation.

DANCE COURSES

DANC 408 Choreography III. (3) Prerequisite: DANC 308 or audition. Theoretical and creative aspects of Choreography for small groups. Emphasis on individual projects. Repeatable to a maximum of 6 credits.

DANC 410 Dance Production II. (3) One lecture and four labs. Prerequisite: DANC 210. Continuation of DANC 210.

DANC 411 Dance Management and Administration. (3) Prerequisite: DANC 210. Principles of Dance Management and administration, including organization of touring, bookings, budgets, public relations, grantsmanship and audience development.

DANC 428 Principles of Pointe Work and Partnering. (2) Prerequisite: DANC 329 or audition. An introduction to pointe work for the advanced female student pursuing the tradition of classical ballet. Principles of partnering for the male dance student. Repeatable to a maximum of 4 credits.

DANC 429 Ballet Variations and Repertory. (3) Pre- or corequisite: DANC 428. Choreography, music, scenario and staging of standard works in ballet. Repeatable to a maximum of 6 credits.

DANC 430 Dance Ethnology. (3) Social and cultural aspects of Dance in world cultures with emphasis on non-Western peoples.

DANC 448 Modern Dance VII. (3) Prerequisite: DANC 349 or audition. Advanced technique in Contemporary Dance with emphasis on physical and expressive skills. Repeatable to a maximum of 6 credits.

DANC 449 Modern Dance VIII. (3) Prerequisite: DANC 448 or audition. Intensive work in modern technique for the professionally oriented dancer. Repeatable to a maximum of 6 credits.

DANC 468 Modern Repertory. (3) Prerequisite: DANC 165 and 249 and permission of the instructor. The form, content, music, design and performance of selected works of well known modern choreographers, including Humphrey, Graham and Limon. Repeatable to a maximum of 6 credits.

DANC 471 Movement Behavior. (3) Prerequisite: DANC 165. The social psychology of movement; reciprocity of physical and emotional behavior.

DANC 482 History of Dance I. (3) The development of Dance from primitive times to the Middle Ages and the relationship of dance forms to patterns of culture.

DANC 483 History of Dance II. (3) The development of Dance from the Renaissance Period to the present time and the relationship of dance forms to patterns of culture.

DANC 484 Philosophy of Dance. (3) Prerequisite: DANC 482, or 483 or permission of instructor. Critical analysis of Dance as a creative experience and the role of professional, educational and recreational dance in our society. Study of selected approaches to current developments in Dance.

DANC 485 Survey of Dance Literature. (3) Prerequisite: DANC 482 and 483. Research methods and bibliography in Dance.

DANC 486 Movement and Media. (3) Two lectures and two laboratory periods. Prerequisite: Permission of instructor. Theory and practice of recording solo and group dances on film and video-tape. Analysis of

significant dance films, photographic lighting and editing techniques.

DANC 489 Special Topics in Dance. (1–3) Prerequisite: Consent of the department chairman. Repeatable to a maximum of 6 credits provided subject matter is different.

DANC 499 Dance Workshop IV—Practicum. (1–6) Prerequisite: Permission of the department chairman. Advanced workshop in dance presentation, including performing, production and planned field experiences. Repeatable to a maximum of 6 credits.

ENGINEERING, COOPERATIVE EDUCATION COURSES

ENCO 408 Co-Op Internship. (0) Professional internship in industry or government agency provides the practical work experiences which supplement and enhance the theories, principles and practices in the normal educational program. The student should register for ENCO 408 for each summer internship. He should register for both ENCO 408 and ENCO 409 for each semester internship.

ENCO 409 Co-Op Internship. (0) Professional internship in industry or government agency provides the practical work experiences which supplement and enhance the theories, principles and practices studied in the normal educational program. The student should register for ENCO 408 for each summer internship. He should register for both ENCO 408 and 409 for each summer internship.

ENGINEERING SCIENCE COURSES

ENES 401 Technological Assessment. (3) Intended for seniors not majoring in Engineering. Not applicable as a technical elective for Engineering majors. Analysis of assessing technology in terms of goals and resources. Public and private constraints, changes in objectives and organization. Applications to Engineering technology.

ENES 405 Power and the Environment. (3) Intended for seniors not majoring in Engineering. Not applicable as a technical elective for Engineering majors. An introduction to the power needs of society. The interrelationship between man's use of energy and the effect on the eco-system. Introduction to the techniques of power production with special emphasis on nuclear fueled power plants.

ENES 414 Solar Energy Applications in Buildings (3) Prerequisite: PHYS 262 or consent of instructor. Methods of utilizing solar energy to provide heating, cooling, hot water, and electricity for buildings; survey of related techniques for reducing energy consumption in buildings. Solar collectors, heating and cooling systems, water heaters, energy storage, solar cells, solar-thermal power systems. Quantitative evaluation of system efficiences; economics of solar energy utilization; structural and esthetic integration of solar collectors and system components into building designs.

ENES 473 Principles of Highway and Traffic Engineering. (3) Prerequisite: Permission of instructor. Designed to assist the non-engineer in understanding highway transportation systems. A survey of the fundamentals of traffic characteristics and operations. Study of the methods and implementation of traffic control and regulation. An examination of highway design procedures, and the role of traffic engineering in transportation systems safety improvements.

ENGINEERING TECHNOLOGY, FIRE SERVICE COURSES

ETFS 402 Fire Safety Research and Transfer. (3) Two lectures and one laboratory period a week. An evaluation of scope and methods utilized to accomplish technological transfer of scientific finding to the application of problem situations in public fire safety. An examination of ongoing and reported research.

ETFS 405 Technical Problem Analysis. (3) Two lectures and one laboratory period a week. Prerequisites: 12 hours of upper division courses in Fire Science. The development of student awareness and competency relating to concepts of research analysis. Each student develops a research design and carries out a study project. Individual studies are culminated with a project paper.

ENGINEERING, FIRE PROTECTION COURSES

ENFP 411 Fire Protection Hazard Analysis. (3) Prerequisites: ENFP 251, 310, corequisite: ENFP 415. Examination of diffusion flame phenomena and material flame propagation and development in industrial and related environments. Synthesis of design procedures relative to the total application of Fire Protection Engineering with economic and cost benefit analysis.

ENFP 414 Life Safety Systems Analysis. (3) Prerequisite: ENFP 321. Detailed examination and study of the physical and psychological variables related to the occurrence of fire casualties. The investigation of functional features of smoke movement and egress. Review of systematic procedures for analysis of life safety in structures, and the incorporation of such procedures into the design process.

ENFP 415 Fire Protection System Design II. (3) Prerequisite: ENFP 310, 312. Study of gaseous and particulate fire suppression systems plus hazard detection systems. Examination and evaluation of code criteria, performance specifications and research relation to the study areas. Application of fluid theory to the design layout and the calculation procedures for gaseous and particulate fire suppression systems. Functional analysis and design layout of detection systems. An integrated fire protection systems design project.

ENFP 416 Problem Synthesis and Design. (3) Prerequisite: Senior standing. Techniques and procedures of problem orientation and solution design utilizing logical and numerical procedures. Student development of research projects in selected areas.

ENFP 489 Special Topics. (3) Prerequisite: Permission of the department. Selected topics of current importance of fire protection. Limited to a total of 6 credits.

FOREIGN LANGUAGE COURSES

FOLA 408 Foreign Language I. (3) Intensive study of a foreign language or related topic not available under one of the current foreign language departments or programs. May not be used to fulfill the arts and humanities language requirement.

FOLA 409 Foreign Language II. (3) Prerequisite: FOLA 408 in the same language or topic. A continuation of FOLA 408. May not be used to fulfill division of arts and humanities language requirement.

FOLA 459 Foreign Literature in Translation. (3) Reading and discussion of selected authors, periods or genres of a foreign literature not otherwise offered. May be repeated for six credits in a single literature if content is different. All readings and instruction in English.

GEOLOGY COURSES

GEOL 421 Crystallography. (3) Two lectures and one laboratory a week. Prerequisite: MATH 115 or consent of instructor. An introduction to the study of crystals. Stresses the theoretical and practical relationships between the internal and external properties of crystalline solids. Encompasses morphological, optical and chemical crystallography.

GEOL 422 Mineralogy. (4) Two lectures and two laboratories a week. Prerequisite: GEOL 110 and CHEM 103, or consent of instructor. Basic Mineralogy for Geology majors. The principles of Morphologic Crystallography. Crystal Chemistry, and Determinative Mineralogy. Two lectures and two laboratories a week. Prerequisite: GEOL 110 and 421 or consent of instructor. Basic Elementary Mineralogy with emphasis on description, identification, formation, concurrence and economic significance of approximately 150 minerals.

GEOL 423 Optical Mineralogy. (3) One lecture and two laboratories a week. Prerequisite: GEOL 422 or consent of instructor. The optical behavior of crystals with emphasis on the theory and application of the petrographic microscope.

GEOL 431 Invertebrate Paleontology. (4) Three lectures and one laboratory a week. Prerequisite: GEOL 102 or consent of instructor. A systematic review of the morphology, classification, interrelationships and geologic significance of all the commonly fossilized invertebrate phyla.

GEOL 432 Stratigraphic Paleontology. (3) Two lectures and one laboratory a week. Prerequisite: GEOL 431. Principles of Biostratigraphy, Paleoecology and Pateogeography. Laboratory study emphasizes significant index fossils.

GEOL 434 Micropaleontology. (3) Two lectures and one laboratory a week. Prerequisite: GEOL 431 or consent of instructor. A systematic review of the morphology, classification, ecology and geologic ranges of important microfossil groups, particularly ostracoses and foraminifera.

GEOL 436 Regional Geology of North America. (3) Prerequisite: GEOL 102 or consent of the instructor. A systematic study of the regional geology of North America including history, structure, stratigraphy and petrology of the physiographic provinces of the United States, Canada and the Caribbean.

GEOL 441 Structural Geology. (4) Three lectures and one laboratory a week. Prerequisite: GEOL 110 and 112, or consent of instructor. An examination of the deformation of the earth's crust; stress and strain; mechanical behavior of rocks; origin and significance of structural features. Construction of geologic maps and cross sections; stereographic and orthographic representation of structures.

GEOL 442 Sedimentation. (3) Two lectures and one laboratory a week. Prerequisite: GEOL 322 or 422 or consent of instructor. A study of the critical variables in sedimentation systems; origin, dispersion accumulation, and properties of sediments and sedimentary rocks. Laboratory exercises include the quantitative estimation of composition and textural parameters of sediments, the description and petrologic interpretation of representive sedimentary rocks, and field laboratory problem. A three-day field trip is required. Two lectures and one laboratory a week. Prerequisite: GEOL 110 or consent of instructor. A study of the critical variables in sedimentation systems; origin, dispersion, accumulation, and properties of sediments and sedimentary rocks. Laboratories will include the measurement and statistical analysis of sediment properties and study of sedimentation rates.

GEOL 443 Petrology. (3) Prerequisite: GEOL 422 or consent of instructor. Two lectures and one laboratory per week. A detailed study of rocks: petrogenesis; destributions; chemical and mineralogical relation; macroscopic descriptions and geologic significance.

GEOL 444 Petrography. (3) One lecture and two laboratories a week. Prerequisites: GEOL 423, 442 or consent of instructor. Microscopic thin-section studies of rocks stressing the description and classification of igneous and metamorphic rocks.

GEOL 445 Principles of Geochemistry. (3) Three lectures per week. Prerequisites: CHEM 103 and GEOL 422. An introduction to the basic principles of geochemistry including geothermometry, geobarometry, geochronology and the genesis of natural inorganic materials.

GEOL 446 Geophysics. (3) Two lectures and one laboratory a week. Prerequisite: PHYS 122 or consent of instructor. An introduction to the basic theories and principles of geophysics stressing such important applications as rock magnetism, gravity anomolies, crustal strain and earthquakes, and surveying.

GEOL 447 Geochemistry of Fuels. (3) Prerequisite: CHEM 104 or consent of instructor. Discussion of the progenitors and the biochemical, chemical and physical agencies that convert them into crude oils, coals of various ranks, natural gas and other organic fuels. The origin, composition, mineralogy and organic constituents (kerogen) of oil shales. Mineralogy, geochemical cycles and accumulation of uranium and thorium.

GEOL 450 Economic Geology of Energy Sources. (3) Problems related to current methods for exploration for and recovery of crude oils, coals, asphalts, tar sands, oil shales, gas, uranium, and geothermal energy. Geological, geochemical, engineering, economic and environmental considerations.

GEOL 451 Groundwater Geology. (3) Prerequisite: GEOL 100 or consent of instructor. An introduction to the basic geologic parameters associated with the hydrologic cycle. Problems in the accumulation, distribution and movement of groundwater will be analyzed.

GEOL 452 Geological Oceanography. (4) Prerequisite: Geology 475 and consent of instructor. Study of marine and estuarine environments with special attention to present geological and geochemical processes. Origin and evolution of basins, margins, sediments and water; sediment-water and basalt-water interactions; environmental effects of societal actions; oceanographic and laboratory techniques; Chesapeake Bay processes. Shipboard excursions required. Laboratory workups on collected samples, conducted on an individual basis to the interests of the student.

GEOL 453 Economic Geology. (3) Two laboratories a week. Prerequisite: GEOL 422 or consent of instructor. A study of the geology of metallic ore deposits stressing ore-forming processes, configuration of important ore bodies, and familiarization with characteristic ore mineral suites.

GEOL 456 Engineering Geology. (3) Prerequisite: GEOL 441 or consent of the instructor. **Two lectures and one laboratory a week. A study of the geological problems associated with the location of tunnels, bridges, dams and nuclear reactors, slope control, and natural hazards.**

GEOL 460 Earth Science. (3) Two lectures and one laboratory a week. Prerequisite: Permission of instructor. An interdisciplinary course designed to show how geology, meteorology, physical geography, soil science, astronomy and Oceanography are interrelated in the study of the earth and its environment in space. Recommended for Science Education.

GEOL 462 Geological Remote Sensing. (3) One lecture and two laboratories a week. Prerequisites: GEOL 441 and 442, or 440, or consent of the instructor. An introduction to geological remote sensing including applications of aerial photographic interpretation to problems in regional geology, engineering geology, structural geology, and stratigraphy. Films, filters, and criteria used in selecting imagery are also discussed. Laboratory exercises include measurements of geologic parameters and compilation and transference of data to base maps.

GEOL 471 Geochemical Methods of Analysis. (3) Prerequisite: CHEM 103 and 104. Principles and application of geochemical analysis as applied to a variety of geological problems. X-ray and optical spectroscopy, X-ray diffraction, atomic absorption, electron microprobe and electron microscopy.

GEOL 472 Tectonics. (3) Prerequisite: GEOL 441 or consent of instructor. Selected tectonic elements of organic belts through out the world viewed in the framework of plate tectonics and sea floor spreading.

GEOL 475 General Oceanography. (3) Three lectures per week. Prerequisite: CHEM 103 or equivalent, and one additional semester of physical science. An introduction to physical, chemical and geological processes that occur in the marine environment including physical and chemical properties of sea water, geology of the sea floor, general circulation of the ocean, currents, waves, and tides.

GEOL 476 Geochemistry of Biosphere. (3) Prerequisite: Two years of chemistry including one year of either organic or physical chemistry. An interdisciplinary approach involving inorganic, organic, physical and biochemistry to integrate the available information necessary to interpret and explain the major aspects of the geochemistry of the biosphere.

GEOL 489 Special Topics in Earth Science. (1–3) Prerequisite: GEOL 460 or equivalent.

GEOL 490 Geology Field Camp. (6) Prerequisites: GEOL 422, 431 and 441, or consent of instructor. Six weeks of summer field work prior to senior year. Principles and problems in sampling, measuring, mapping, and reporting of geologic data. Group field trips and discussions.

GEOL 499 Special Problems in Geology. (1–3) Prerequisites: GEOL 102 and 110 or equivalent, and consent of instructor. Intensive study of a special geologic subject or technique selected after consultation with instructor. Intended to provide training or instruction not available in other courses which will aid the student's development in his field of major interest.

GREEK COURSES GREK 400 level course prerequisite: The status of advanced undergraduate or graduate and consent of the instructor.

GREK 401 Thucydides. (3)

GREK 402 Greek Philosophers. (3)

GREK 403 Greek Tragedy. (3)

GREK 404 Greek Comedy. (3)

GREK 405 Greek Oratory. (3)

GREK 406 Greek Epigraphy. (3)

GREK 488 Independent Study in Greek Language and Literature. (1–3) Permission of departmental chairman and instructor required. Repeatable to a maximum of 6 credits.

GREK 499 Greek Readings. (3) Prerequisite: Consent of the instructor. The reading of one or more selected Greek authors. Reports. May be repeated with different content.

HEBREW COURSES

HEBR 423 The Hebrew Bible in Translation I. (3) Selected readings from the Bible and its commentaries, classical and modern. Major concepts of Biblical thought.

HEBR 424 The Hebrew Bible in Translation II. (3) A continuation of HEBR 423.

HEBR 431 Modern Hebrew Literature. (3) Prerequisite: HEBR 301 or equivalent. Selected readings from the major Hebrew prose writers of the 20th century such as J. Steinberg, Burla, Berkovitz, Shofman and Agnon describing traditional Jewish life in the Diaspora mileu and in the land of Israel.

HEBR 432 Contemporary Hebrew Literature. (3) Prerequisite: HEBR 301 or equivalent. The problems facing modern man as reflected in the writings of Agnon, Hazaz, Meged, Yehoshua, Amichai, and others. Training in literary criticism. Reading of periodicals dealing with current literary trends.

HEBR 441 Studies in Classical Hebrew and Epigraphy. (3) Prerequisite: HEBR 115 or equivalent. Linguistic peculiarities of Classical Hebrew from pre-Biblical epigraphic records to the Dead Sea Scrolls. Application of the method of literary form criticism to epic poetry and Thanksgiving songs, cultic formulae, historical annals and narratives.

HEBR 442 Classical Hebrew Literature. (3) Prerequisite: HEBR 115 or equivalent. Pentateuchal source analysis, prophetic oracles, Biblical law in comparison with other ancient codes, wisdom literature, the apocalyptic form and the manual of discipline of the Dead Sea Scrolls.

HEBR 498 Special Topics in Hebrew. (3) Prerequisite: As announced in the schedule of classes for each topic. Repeatable for a maximum of six credits provided the content is different.

HUMAN AND COMMUNITY RESOURCES COURSES

DHCR 400 The Future of the Human Community (3) Examination of the future and of our social and cultural institutions for education and child-rearing, social and family relationships, health and leisure, information exchange, and the provision of food, clothing, and shelter.

DHCR 488 Selected Topics in Human and Community Resources. (1–3) Topics in interdisciplinary processes relevant to the study of human and community resources. Repeatable to a maximum of six credits when the subject matter is different and when there is no sufix.

DHCR 788 Advanced Topics in Human and Community Resources. (3) Topics in interdisciplinary areas relevant to the study of Human and Community Resources. Repeatable to a maximum of six credits if the subject matter is different.

HOUSING AND APPLIED DESIGN COURSES

HSAD 440 Interior Design III. (4) Eight hours studio periods. Prerequisite: HSAD 344. Preparation of complete presentation: work specifications, floor plans, purchase orders, renderings, etc. portfolio preparation.

HSAD 441 Interior Design IV. (4) Eight hours studio periods. Prerequisite: HSAD 440. Preparation of complete presentation: work specifications, floor plans, purchase orders, renderings, etc. portfolio preparation.

HSAD 442 Barrier-Free Interiors I. (3) Prerequisite: APDS 101A or equivalent and consent of instructor. An introduction to determinants of design decisions in relation to the handicapped, aging and disabled: physical limitations and design support systems.

HSAD 443 Barrier-Free Interiors II. (3) Prerequisites: HSAD 343, HSAD 442. Three studio periods. Experience in solving problems related to interior space, both individual and congregate, and its use by the handicapped, aging and disabled.

HSAD 458 Readings in Housing. (3) Prerequisite: SOCY 100 and consent of instructor. Readings in depth under the guidance of a faculty member on one or more facets of housing, in support of individual interests in urban renewal, public housing, etc. Repeatable to a maximum of six credits.

HSAD 488 Selected Topics in Housing and Interior Design. (1–6) Offered on demand. May be repeated to a maximum of six hours.

HSAD 499 Individual Study in Housing and/or Interior Design. (3–4) Guidance for the advanced student capable of independent subject matter investigation or creative work. Problem chosen with consent of instructor.

HSAD 658 Special Topics in Housing and Interior Design. (3–6) Individual study or arranged group study. May be repeated to a maximum of six hours.

INFORMATION SYSTEMS MANAGEMENT COURSES

IFSM 401 Electronic Data Processing. (3) The electronic digital computer and its use as a tool in processing data. Organization of data processing systems; environmental aspects of computer systems; and management control problems and potentials inherent in mechanized data processing systems. IFSM 202 and 401 cannot both be taken for credit.

IFSM 402 Construction of Computer-Based Information Systems. (3) Prerequisite: IFSM 202 or IFSM 401 or permission of instructor. The advanced concepts and tools necessary for the construction of computer-based information systems. Information systems architecture, data and storage structures, operating system and software support functions, and hardware characteristics. Advanced features of a programming language, operating system command languages and data definition and manipulation languages. Emphasis on structured programming, adequate testing and documentation standards.

IFSM 410 Information Processing Problems of Models of Administrative, Economic and Political Systems. (3) Prerequisites: MATH 141 or equivalent, IFSM 402, BMGT 231, and some familiarity with administrative, economic and/or political models. Prerequisites may be waived with the consent of instructor. Data processing requirements underlying the creation and maintenance of a data base to be used in estimating the parameters of socio-economic models. An analysis of the structure and development of recent socio-economic models as relevant to data processing considerations. Extractions and preparation of data from the data base to facilitate the appropriate transformation necessary for model construction and also to minimize the processing cost of data in-put. The course draws upon a knowledge of models of administrative, economic and political systems. Case studies and experience with data processing for selected models are included.

IFSM 420 Information Processing and Computational Problems in Operations Analysis. (3) Prerequisites: MATH 141 or equivalent; IFSM 402, and a course in Statistics, such as BMGT 430, dealing with multivariate models. Prerequisites may be waived with the consent of the instructor. Implementation of applications requiring the integration of data processing and analytical programming techniques. Such applications feature the calculation of various statistical estimates of the parameters in a multivariate model within the context of a file maintenance problem (e.g., the writing of a matrix inversion routine for revenue forecasting within a master updating program or sales forecasting and/or sales performance evaluation within a sales transaction-master updating program). A universal, problem-oriented language such as Cobol will be used with strong emphasis on the use of the mathematical Fortran IV library subroutines. Class projects include case studies and solutions of problems using real-world data.

IFSM 436 Introduction to Systems Analysis. (3) Prerequisites: IFSM 402; BMGT 430; MATH 141 or MATH 221; or equivalent; or permission of instructor. The use of the computer in the management and operation of organizations. The principles of systems analysis; recent applications and innovations of the systems concept; design and implementation of computer systems, including such techniques as mathematical programming, simulation, business games and network analysis; and the laboratory use of a digital computer in the application of these techniques.

IFSM 483 Information Systems as a Research Tool. (3) Prerequisite: Permission of department. Strategies for collecting, organizing and using data. Understanding systems interfaces: command language; aspects of running special packages (statistics, operations research, etc.); library and archival storage; effect of charge-back policy. Portability and transferability of program and data; use of networks. Emphasis on general concepts illustrated by the local environment with problems selected from situations facing students in the class. Not intended for IFSM or CMSC students.

IFSM 498 Special Topics in Information Systems. (1–3) Permission of instructor. Topics in the design and implementation of Information Processing Systems. Repeatable to maximum of six credits when topics differ.

IFSM 606 Information Systems Technology. (3) Introduction to graduate courses in IFSM, a survey for interested graduate students in other fields. The concepts, theory and techniques of Information Systems. The system life cycle. The role of Information Systems in the management and control of the organization. Effectiveness measures of Information Systems. Case studies of Information Systems as developed by industry and government. Societal impact.

IFSM 610 Design of Large-Scale Information Processing Systems. (3) Prerequisites: IFSM 410 and 436 or consent of instructor. Characteristics of large-scale Information Processing Systems. Relationship of model-building and simulation to Information Processing System design. Design elements and phases. Programming techniques for large-scale Information Processing Systems, including time sharing and real-time. Special projects include case studies and the design of a large-scale Information Processing System.

IFSM 620 Management of Information Processing Systems. (3) Prerequisite: IFSM 436 or consent of instructor. Administrative uses and limitations of high-speed computers in an Information Processing System. Limitations as related to system structure and methods used to originate and process data. Planning and installation of a total information processing system including conversion problems. Measures of information processing effectiveness. Documentation procedures. Data security, legal considerations and auditing the Information Processing System. Personnel requirements for an on-going system. The broad statement of the system requirements is taken as given.

IFSM 630 Application of Advanced Developments in Information Processing Equipment. (3) Prerequisite: IFSM 610 or consent of instructor. A study and an evaluation of the operational and hardware characteristics of the computer and peripheral equipment available to meet the specification of the broad classes of Information Processing Systems, including coding systems, error-detecting and software considerations. Data communicating devices, including the functional characteristics of long-line, telephone channel, transceiver and communication satellites. Case studies and examples.

IFSM 698 Special Topics in Information Systems Technology. (1–3) Prerequisite: IFSM 606 or permission of instructor. Advanced topics in the specification, analysis and implementation of large scale information systems. Repeatable to a maximum of six credits provided the content is different.

IFSM 721 Requirements Analysis and Logical Design of Information Systems. (3) Prerequisite: IFSM 606 or permission of instructor. The life cycle of an Information Processing System. The early part of the life cycle, i.e., the perception of need and the collection of requirements. Feasibility analysis of proposed information processing systems. Techniques for statement of the requirements of an Information Processing System, ranging from the early Industrial Engineering originated methods to current computer-aided ones. Concepts of logical design from the synthesis of requirements.

IFSM 722 The Physical Design of Information Systems. (3) Prerequisite: IFSM 606 or permission of instructor. Mapping the logical design to the available hardware and off-the shelf software l in the 'best' way possible. Human factors and social implications.

IFSM 723 Database Technology. (3) Prerequisite: IFSM 606 or permission of instructor. The concepts, theory and models of data, its structure, manipulation, and storage. The various architectures of Data Management Systems. Evaluation and selection of database systems.

IFSM 724 Application of Management Methods to Information Systems. (3) Prerequisites: IFSM 606, BMGT 734 or equivalent. Theory and practice of management techniques from strategic planning to system acquisition to operation as applied to Information Systems. Methods of organizing the information center, allocation of chargeback policies, performance monitoring and projection, security and integrity evaluation, project selection and staffing, outside services for resource leveling.

IFSM 788 Seminar in Information Systems. (1–3) Prerequisite: IFSM 606 or permission of instructor. A seminar of advanced topics in the operation, user interface, management and social implications, and conceptual methods of large scale information systems. Repeatable to a maximum of six credits provided the topic is different.

JAPANESE COURSES

JAPN 418 Japanese Literature in Translation. (3) Representative works of Japanese literature in translation. May be repeated for a total of nine credits when content differs.

JAPN 499 Directed Study in Japanese. (1–3) Prerequisite: Permission of instructor. Repeatable to a maximum of six credits.

LATIN COURSES LATN 400 LEVEL COURSE PREREQUISITE: LATN 361

LATN 401 Catullus and the Roman Elegiac Poets. (3)

LATN 402 Tacitus. (3)

LATN 403 Roman Satire. (3)

LATN 404 Roman Comedy. (3)

LATN 405 Lucretius. (3)

LATN 411 Advanced Latin Grammar. (3) Prerequisite: Three years of college Latin or equivalent. An intensive study of the morphology and syntax of the Latin language supplemented by rapid reading.

LATN 488 Independent Study in Latin Language and Literature. (1–3) Permission of departmental chairman and instructor required. Repeatable to a maximum of 6 credits.

LATN 499 Latin Readings. (3) Prerequisite: Consent of instructor. The reading of one or more selected Latin authors from antiquity through the Renaissance. Reports. May be repeated with different content.

LATN 610 Vulgar Latin Readings. (3) Prerequisite: Consent of instructor. An intensive review of the phonology, morphology, and syntax of classical Latin, followed by the study of the deviations of Vulgar Latin from the classical norms, with the reading of illustrative texts. The reading of selections from the Peregrinatio and Loca Sancta and the study of divergences from classical usage therein, with special emphasis of those which anticipate subsequent developments in the Romance languages. Reports.

WOMEN'S STUDIES COURSES

WMST 400 Theories of Feminism. (3) A study of feminist theories from an interdisciplinary perspective, including Politics, Sociology, Psychology, Anthropology, and and Philosophy. Prerequisite: A course on women (ideally WMST 200) or consent of the instructor.

WMST 498 Special Topics in Woman's Studies. (1–3) Repeatable to a maximum of 6 credits. Prerequisite: A course on women (ideally WMST 200) or consent of instructor.

Other University of Maryland Campuses

Baltimore (UMAB)

In addition to programs leading to professional degrees, the following graduate programs for M.S., Ph.D., and M.D.-Ph.D. degrees are offered:
Anatomy, School of Dentistry (M.S., Ph.D.)
Anatomy, School of Medicine (M.S., Ph.D., M.D.-Ph.D.)
Biochemistry, School of Dentistry (M.S.; Ph.D. offered jointly with Department of Biological Chemistry, School of Medicine and UMBC Chemistry Program)
Biological Chemistry, School of Medicine (M.S.; Ph.D. offered jointly with the Department of Biochemistry, School of Dentistry and UMBC Chemistry Program)
Biophysics (M.S., Ph.D.)
Medicinal Chemistry, School of Pharmacy (M.S., Ph.D.)
Microbiology, School of Dentistry (M.S., Ph.D.)
Microbiology, School of Medicine (M.S., Ph.D.)
Nursing, School of Nursing (M.S., Ph.D.)
Oral Pathology, School of Dentistry (M.S., Ph.D.)
Oral Surgery, School of Dentistry (M.S.)
Pathology, School of Medicine
Areas of Specialization:
Medical Pathology (M.S., Ph.D., M.D.-Ph.D.)
Medical Technology (M.S.)
Forensic Toxicology (M.S., Ph.D.)
Pharmacognosy, School of Pharmacy (M.S., Ph.D.)
Pharmacology and Experimental Therapeutics, School of Medicine (Ph.D.)
Pharmacology and Toxicology, School of Pharmacy (M.S., Ph.D.)
Pharmacy—Institutional Pharmacy (M.S.)
Pharmacy—Pharmaceutics (M.S., Ph.D.)
Physiology, School of Dentistry (M.S., Ph.D.)
Physiology, School of Medicine (M.S., Ph.D., M.D.-Ph.D.)
Social Welfare, School of Social Work and Community Planning (D.S.W.)

CONTACT:
Dean for Graduate Studies and Research
University of Maryland at Baltimore
Baltimore, Maryland 21201
(301) 528–7131

BALTIMORE COUNTY (UMBC)

Programs offered:
Applied Mathematics (M.S., Ph.D.)
Applied Sociology (M.A.)
Biochemistry (M.S., Ph.D.)
Chemical Physics (M.S.)
Chemistry Related to Health Sciences (M.S.)
Community-Clinical Psychology (M.A.)
Experimental Biology-Health Sciences (M.S., Ph.D.)
Historical Studies (M.A.)
Instructional Systems Development (M.A.)
Marine-Estuarine-Environmental Science (M.S., Ph.D.)
Policy Sciences (M.P.S., Ph.D.)

Contact:
Dean for Graduate Studies and Research
University of Maryland Baltimore County
5401 Wilkens Avenue
Catonsville, Maryland 21228
(301) 455–2538

EASTERN SHORE (UMES)

Programs offered:
Guidance and Counseling (M.Ed.)
Marine-Estuarine-Environmental Science (M.S., Ph.D.)

Contact:
Asst. Vice Chancellor for Graduate Studies
University of Maryland Eastern Shore
Princess Anne, Maryland, 21853
(301) 651–2200 (exts. 205–209)

University College (UMUC)

University of Maryland University College (UMUC) is the continuing education campus of the University system, offering courses and programs of study designed primarily to meet the unique needs of the part-time undergraduate student. In addition, UMUC offers the Master of General Administration, a graduate degree with a focus on human resources management. UMUC will also continue to serve the increasing number of students engaged in part-time graduate study by providing upper level and graduate course work in other areas of demand.

Contact:
Dean for Graduate Studies
University of Maryland
University College
University Boulevard and Adelphi Road
College Park, Maryland, 20742
(301) 454–4755

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